USDA Natural Resources
Conservation Service

Ecological site R003XN543WA
Southern Washington Cascades Alpine Tundra

Last updated: 9/09/2023
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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 003X–Olympic and Cascade Mountains

Steep mountains and narrow to broad, gently sloping valleys characterize this region. A triple junction of two oceanic plates and one continental plate is directly offshore from Puget Sound. Subduction of the oceanic plates under the westerly and northwesterly moving continental plate contributes to volcanic activity in the Cascades. Movement between these plates has resulted in major earthquakes in this area in the past and the formation of large stratovolcanoes. The Cascade Mountains consist primarily of volcanic crystalline rocks with some associated metasedimentary rocks. The average annual precipitation ranges from 60 to 100 inches in much of the region and 30 to 60 inches on the east side of the Cascade Mountains.

The dominant soil orders in this MLRA are Andisols, Spodosols, and Inceptisols, with minor amounts of Entisols, and Histosols. The soils in the area dominantly have a frigid or cryic soil temperature regime and an udic soil moisture regime. They generally are shallow to very deep, well drained, ashy to medial, and loamy or sandy and occur on mountain slopes and ridges.

Ecological site concept

This ecological site is typically found at the higher elevations of the Southern Washington Cascades and Mt. Rainier that comprise the upper limits of plant growth, at elevations ranging from 4,600 to 11,000 ft. While this ecological site has a broad range in elevation, it is most commonly found from 7,000 to 11,000 feet. The primary abiotic factors that drive this ecological site are lack of precipitation from a rain shadow and high elevations that result in cool temperatures even in the summer, extremely cold winters, high winds, intense solar radiation, short growing season, and heavy snow pack. As a result, plants are more sparsely located on the landscape and adapted to very challenging growing conditions.
Soils that support this ecological site occur in the cryic soil temperature regime and the udic soil moisture regime and are formed in volcanic ash and colluvium. They are coarse textured, and are low in organic matter. The site is often buried under a heavy snow load which provide more insulation for plants during the dormant season, and often result in a significantly shorter growing season that other sites on Mt. Rainier.
Common plants include Davis' knotweed (*Polygonum davisiae*), tundra aster (*Oreostemma alpigenum* var. alpigenum), alpine leafybract aster (*Symphyotrichum foliaceum* var. foliaceum), Penstemon (Penstemon sp.), common yarrow (*Achillea millefolium*), common juniper (*Juniperus communis* var. montana), spreading phlox (*Phlox diffusa*), Tiling's monkeyflower (*Mimulus tilingii*), arctic lupine (*Lupinus arcticus*), and asachinea lichen (Asahinea).

Associated sites

R003XN542WA	**Southern Washington Cascades Subalpine Parkland** Ecological Site R003XN543WA, Southern Washington Cascades Alpine Tundra, and Ecological Site R003XN542WA, Southern Washington Cascades Subalpine Parkland have some associated climatic and physiological features. However, Ecological Site R003XN543WA has a much higher elevation range which limits the growing season and impacts vegetation growth and production considerably. As a result, Ecological Site R003XN542WA is able to grow a wider variety of vegetation species with increased growth production when compared to Ecological Site R003XN543WA.

Similar sites

R003XN544WA	**Southern Washington Cascades Wet Alpine Tundra** Ecological sites R003XN544WA, Southern Washington Cascades Wet Alpine Tundra, and R003XN543WA, Southern Washington Cascades Alpine Tundra, have some similar climatic and physiological features. Ecological site R003XN544WA is at lower elevations that are slightly warmer and receive more precipitation as compared to site R003XN543WA. As a result of increased moisture availability, site R003XN544WA supports a wider variety of vegetation species that have higher production as compared to site R003XN543WA.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Polygonum davisiae* (2) *Lupinus arcticus*

Physiographic features

This ecological site occurs across many landscape positions on volcanic cones, ridges, and cirques in the Cascade Mountains (4,600-11,000 ft) in Mt. Rainier National Park. The site is found on most slopes, however it most commonly occurs between 10 to 65 percent slopes.

Table 2. Representative physiographic features

Landforms	(1) Volcanic cone (2) Ridge (3) Cirque
Flooding frequency	None
Ponding frequency	None
Elevation	4,600–11,000 ft
Slope	5–100%
Water table depth	10–0 in
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This ecological site receives most of its annual precipitation from October to March. The mean annual precipitation ranges from 85 to 186 inches and the annual temperature ranges from 26 to 41 degrees Fahrenheit. Microclimate may vary depending on soil temperature and site specific features. Generally, this site occupies areas with cool, dry summers and cold, wet winters.

Table 3. Representative climatic features

Frost-free period (characteristic range)	30-60 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	85-186 in

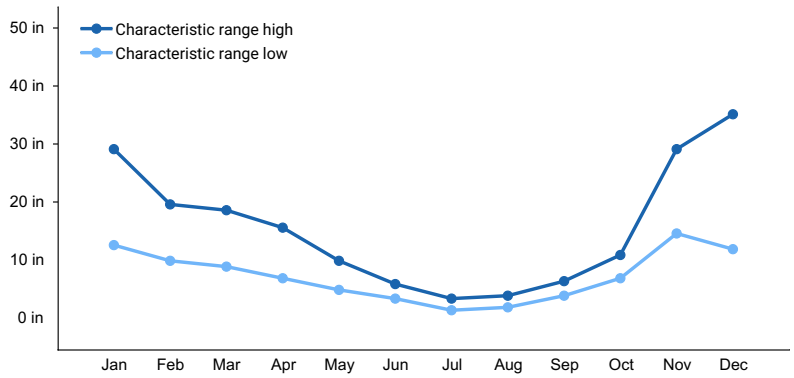


Figure 1. Monthly precipitation range

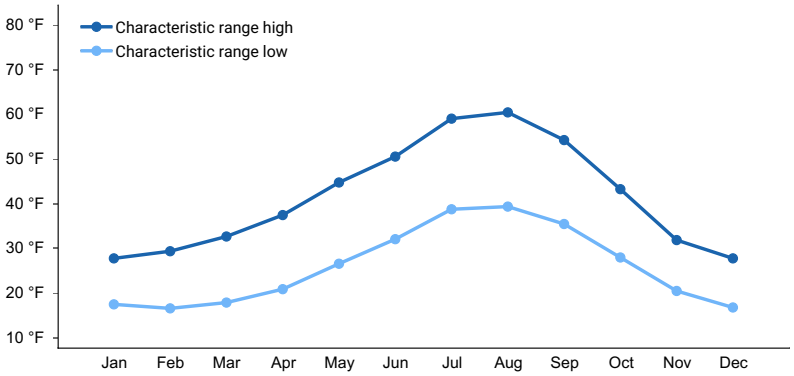


Figure 2. Monthly minimum temperature range

Influencing water features

This site is located in the middle to high elevations on volcanic cones, ridges and cirques in Mount Rainier National Park. This site does not experience ponding or flooding. The water table will typically rise during the spring and summer months and recede in the fall.

Soil features

Applicable Soils: Burroughs, Chenuis, Mountwow, Sarvant, Tatoosh, Wahpenayo

Applicable Soil Map Units within Mt. Rainier National Park: 9260, 9261, 9262, 9996

Soils that support this ecological site occur in the cryic soil temperature regime and the udic soil moisture regime. Soils representative of this ecological site vary in drainage and depth, however the over-riding factor for this ecological site is the position on the landscape and the amount of time and duration of snowpack during the growing season. Burroughs, Chenuis, Sarvant, and Tatoosh soils are well drained. Mountwow and Wahpenayo soils are somewhat poorly drained. Chenuis, and Mountwow soils are very deep. Burroughs, Sarvant and Wahpenayo soils are moderately deep, while Tatoosh soils are shallow. These soils are found on volcanic cones, ridges and cirques and are formed from volcanic ash and andesite colluvium, with or without andesite bedrock. Mountwow and Wahpenayo soils have a seasonally high water table between 10 and 20 inches of the surface at some point during the growing season. None of these soils have flooding or ponding potential. Chenuis and Sarvant soils have greater than 35 percent rock fragments in the control section, while all others do not. Soil textures are coarse, primarily medial sandy loams and medial loamy sands. These soils exhibit andic soil properties in all mineral horizons. Melanization is the dominant pedogenic process and podsolization is not evident in these profiles given the lack of coniferous forest cover. An umbric epipedon and cambic horizons are present in most soils. Thin organic horizons soils, serving to protect the soil from wind and water erosion.

Table 4. Representative soil features

Parent material	(1) Volcanic ash (2) Colluvium–andesite (3) Residuum–andesite
Surface texture	(1) Sandy loam (2) Loamy sand
Drainage class	Well drained to somewhat poorly drained
Soil depth	18–60 in
Surface fragment cover <=3"	0–70%
Surface fragment cover >3"	0–40%
Available water capacity (Depth not specified)	2.5–9 in
Soil reaction (1:1 water) (Depth not specified)	4.5–5.5
Subsurface fragment volume <=3" (Depth not specified)	0–70%
Subsurface fragment volume >3" (Depth not specified)	0–50%

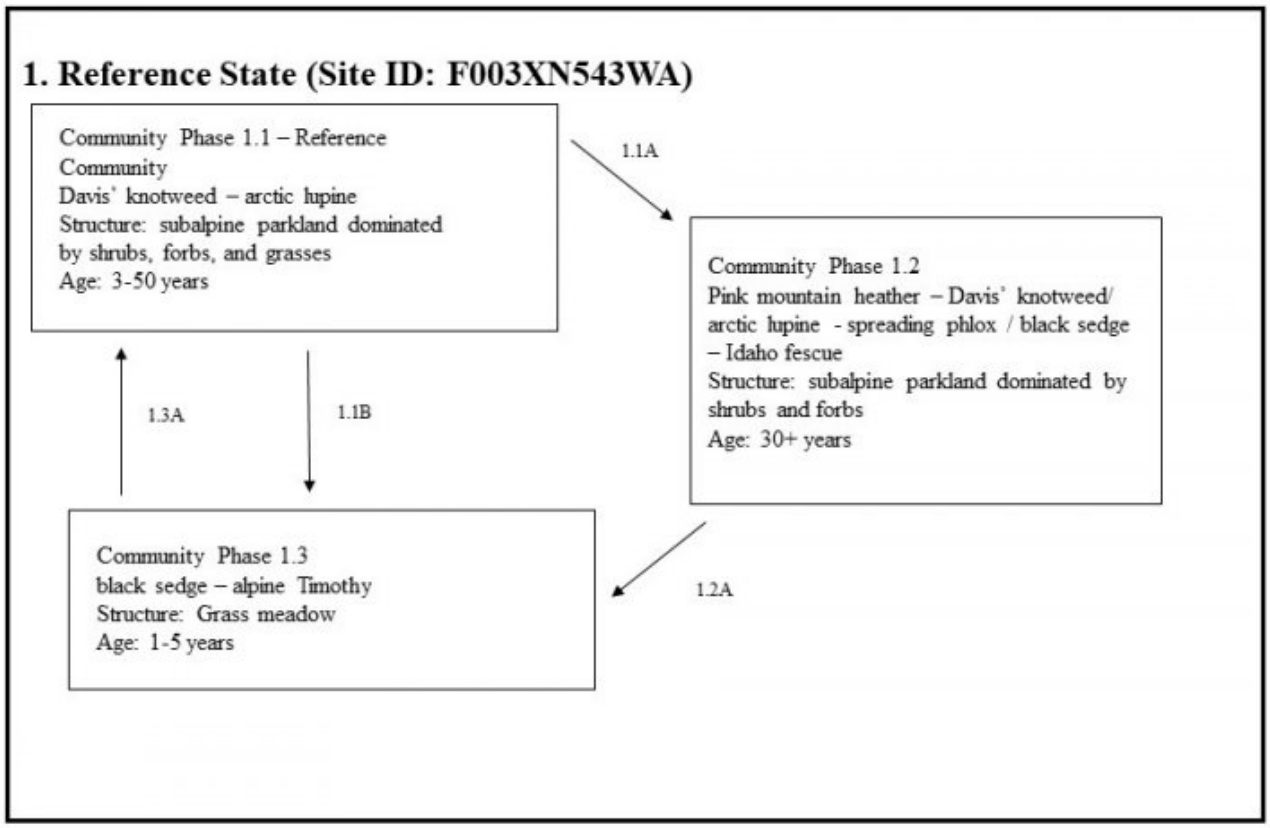
Ecological dynamics

This ecological site is found at middle and high elevations that range from 4,600 to 11,000 feet in the Southern Washington Cascades. The site is typically found at the higher elevation range, between 7,000 to 11,000 feet, which comprise the upper limits of plant growth on Mount Rainier. Plants are specifically adapted to surviving under harsh winters, high winds, intense solar radiation, and a short growing season. Plant production is directly correlated to the snow release date which can be highly variable from year to year. A shorter growing season may impact the ability for plants to flower and disperse seed before snow returns in late summer (Canaday, 1974). These plants are relatively dwarfed in stature and slow growing. These conditions increase plant vulnerability to additional disturbances and take a long period of time to recover. Sites occurring at the lower elevation band are typically affected by unique weather and are located in an area that is cooler than other places at the same elevation due to factors such as proximity to permanent ice.

Soils that support this ecological site occur in the cryic soil temperature regime and the udic soil moisture regime. These soils formed in volcanic ash and colluvium, are coarse textured, and are low in organic matter. The climate is characterized by cool, dry summers and cold, wet winters. The site is often buried under heavy snow load which provide more insulation for plants during the dormant season. As a consequence of the climate, this is one of the latest sites in the subalpine zone to start plant growth in the summer. Also, both air and soil temperatures are significantly cooler, resulting in a significantly shorter growing season than other sites on Mount Rainier. These sites are extremely sensitive to disturbances such as soil compaction and damage to vegetation and recovery may take long periods of time.

The reference community may be most common, but it is likely that all community phases occur as a matrix across the landscape. Common plants include Davis' knotweed (*Polygonum davisiae*), arctic lupine (*Lupinus arcticus*), common yarrow (*Achillea millefolium*), partridgefoot (*Luetkea pectinata*), tundra aster (*Oreostemma alpigenum* var. alpigenum), alpine leafybract aster (*Symphyotrichum foliaceum* var. foliaceum), Penstemon (Penstemon sp.), common juniper (*Juniperus communis* var. montana), spreading phlox (*Phlox diffusa*), Tiling's monkeyflower (*Mimulus tilingii*), and asachinea lichen (Asahinea).

State and transition model



Polygonum davisiae – Lupinus arcticus
Davis' knotweed – arctic lupine

Community Phase Pathway 1.X = Community Phase X#Y = Transition Pathway
1.XY = Pathway (ecological response to natural processes)

State 1

Community 1.1
Davis'knotweed – arctic lupine

Structure: subalpine parkland of shrubs, forbs, and grasses The reference community is sparsely vegetated with a mixture of shrubs, forbs, and grass species that have been relatively undisturbed by natural and human influences. These subalpine ecosystems are located on aspects where snowmelt occurs in mid-summer, which restricts the growing season. Plant percent cover is variable but the reference community plants are common throughout the entire ecological site. Low-growing subshrubs such as Davis' knotweed is most prolific. Pink mountain-heather and common juniper are sometimes present. Forbs including arctic lupine, tundra aster, common yarrow, and spreading phlox cover the landscape with black sedge interspersed. Small natural disturbances such as frost heaving, wind blasting, and variation in snowpack can have significant impacts on alpine vegetation. Soil compaction and damage to vegetation may have significant impacts on the ecological site integrity. Herbivores such as marmots, pikas, elk, migratory birds, and mountain goats will forage on the vegetation which may create patches of open ground (Martin, 2001).

Dominant plant species

- Davis' knotweed (*Polygonum davisiae*), shrub
- pink mountainheath (*Phyllodoce empetriformis*), shrub
- western juniper (*Juniperus occidentalis*), shrub
- arctic lupine (*Lupinus arcticus*), other herbaceous
- tundra aster (*Oreostemma alpigenum var. alpigenum*), other herbaceous
- spreading phlox (*Phlox diffusa*), other herbaceous
- American bistort (*Polygonum bistortoides*), other herbaceous
- black alpine sedge (*Carex nigricans*), other herbaceous

Community 1.2
Pink mountain heather – Davis' knotweed/ arctic lupine - spreading phlox / black sedge – Idaho fescue

Structure: subalpine parkland dominated by shrubs and forbs Community phase 1.2 represents a community stage of shrubs and forbs that are developed over long periods without disturbance. The establishment of shrubs such as pink mountain heather, common juniper, and Davis' knotweed create pockets of low growing vegetation. Common understory species also include arctic lupine and spreading phlox.

Dominant plant species

- pink mountainheath (*Phyllodoce empetriformis*), shrub
- western juniper (*Juniperus occidentalis*), shrub
- Davis' knotweed (*Polygonum davisiae*), shrub
- arctic lupine (*Lupinus arcticus*), other herbaceous
- spreading phlox (*Phlox diffusa*), other herbaceous
- black alpine sedge (*Carex nigricans*), other herbaceous
- Idaho fescue (*Festuca idahoensis*), other herbaceous

Community 1.3
black sedge – alpine Timothy

Structure: Grass meadow As the plant community recovers without disturbance, an increase of grasses and forbs are established. Common plants such as arctic lupine, American bistort, Idaho fescue, and black sedge begin to dominate.

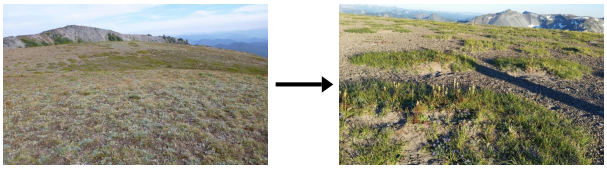
Dominant plant species

- Idaho fescue (*Festuca idahoensis*), grass
- alpine timothy (*Phleum alpinum*), grass
- arctic lupine (*Lupinus arcticus*), other herbaceous
- American bistort (*Polygonum bistortoides*), other herbaceous
- black alpine sedge (*Carex nigricans*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents an ongoing lack of disturbance, which favors the establishment of pockets of shrubs.

Pathway 1.1B
Community 1.1 to 1.3



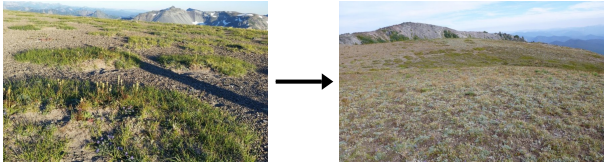
Davis'knotweed – arctic lupine **black sedge – alpine Timothy**

This pathway represents major disturbances, such as continuous snowpack, avalanches, landslides, and slower mass movement, that remove most of the vegetation.

Pathway 1.2A
Community 1.2 to 1.3

This pathway represents extreme disturbances, such as continuous snowpack, avalanches, landslides, and slow mass movement, that remove a majority of the vegetation.

Pathway 1.3A
Community 1.3 to 1.1



black sedge – alpine Timothy **Davis'knotweed – arctic lupine**

This pathway represents an area with no further major disturbance. Continued growth over time has led to increased vertical diversification of forbs.

Additional community tables

Table 5. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
black alpine sedge	CANI2	*Carex nigricans*	Native	1–24	0–30
Forb/Herb					
arctic lupine	LUAR2	*Lupinus arcticus*	Native	1–12	0–30
tundra aster	ORALA2	*Oreostemma alpigenum var. alpigenum*	Native	1–12	0–10
spreading phlox	PHDI3	*Phlox diffusa*	Native	1–6	0–5
American bistort	POBI6	*Polygonum bistortoides*	Native	1–12	0–3
Shrub/Subshrub					
pink mountainheath	PHEM	*Phyllodoce empetriformis*	Native	1–18	1–20
Davis' knotweed	PODA	*Polygonum davisiae*	Native	1–12	1–5

Inventory data references

National vegetation classification group: Northern Rocky Mountain Vancouverian Subalpine-Montane Dry Herbaceous Meadow

U.S. Department of the Interior, National Park Service, plant association: POLDAV

Type locality

Location 1: Pierce County, WA	
Township/Range/Section	T15N R09E S3
Latitude	46° 49′ 12″
Longitude	121° 40′ 15″

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Contributors

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Approval

Kirt Walstad, 9/09/2023

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community

cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	04/27/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**