USDA Natural Resources Conservation Service

Ecological site F043CY501WA
Mesic, Xeric, Loamy Foothills and Canyons (Ponderosa Pine Warm Dry Shrub) Pinus ponderosa/Symphoricarpos albus

Last updated: 9/08/2023
Accessed: 06/02/2024

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): 043C–Blue and Seven Devils Mountains

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Description of MLRAs can be found in: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Available electronically at:
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook

LRU notes

Modal LRU – 43C04 Dissected Basalt Highlands

This LRU is composed predominantly of mid-elevation slopes of foothills, mountains, and canyon walls. The soils tend to be loamy Argixerolls and Haploxerolls with minor ash influence in the surface layer. Colluvium and residuum from basalt are the dominant parent materials. Soil climate is a mesic temperature regime and xeric moisture regime with average annual precipitation around 440 mm (17 inches).

Others where occurring – 43A02 – Eastern High Basalt Plateau

Classification relationships

Relationship to other landscape identification systems:

This ecological site is aligned to the following classification systems:

• U.S. National Vegetation Classification (NVC) standard Central Rocky Mountain Ponderosa pine woodland and Savanna Group (G213), Alliance A3466, Association CEGL000203 (Ponderosa Pine/Snowberry Forest).
• US Forest Service Ecological Sub-region M332G.
• Washington State's Natural Heritage Program's "Northern Rocky Mountain Ponderosa Pine Woodland and Savanna", Central Rocky Mountain Ponderosa Pine Woodland and Savana Group.
• LANDFIRE BpS model 910531 (primary).

Ecological site concept

This ecological site occurs mainly on forested backslopes of hills, mountains, and canyon walls. Parent materials are derived from basalt rock sometimes thinly mantled by volcanic ash and loess. Soils are loamy with water tables at >30 inches depth. There is a minor volcanic ash influence in the surface layer and available water holding capacity is moderate to high. These site represent the warmest, driest forest communities in the LRU.

Associated sites

F043CY504WA	**Warm-Frigid, Xeric, Loamy, Basalt Mountains and Plateaus (Douglas-fir/warm dry shrub)** warm-frigid, xeric, mixed ash surface, basalt geology.

Similar sites

F043CY511WA	**Frigid, Dry-Udic, Loamy, Hills, and Canyons, Basalt, Mixed Ash (grand fir/moist herb)** mixed ash surface
F043CY513WA	**Frigid, Dry-Udic, Loamy, Mountains, and Canyons, Ashy Surface (grand fir/moist herb)** Frigid soil temperature regime
F043CY510WA	**Frigid, Dry-Udic, Loamy, Hills and Mountains, Basalt, Ashy surface (grand fir/moist herb)** Frigid soil temperature regime

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa*
Shrub	(1) *Symphoricarpos albus* (2) *Mahonia repens*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Festuca idahoensis*

Physiographic features

Physiographic Features
This ecological site occurs mainly on forested backslopes of hills, mountains, and canyon walls. Parent materials are derived from basalt rock sometimes thinly mantled by volcanic ash and loess.

Landscapes: Plateaus, Mountains

Landforms: Plateaus, Canyons, Mountain slopes

Elevation:
Total range = 475 to 1275 m
(1,560 to 4,180 feet)
Central tendency = 815 to 1045 m
(2,675 to 3,425 feet)

Slope (percent):
Total range = 0 to 105 percent
Central tendency = 30 to 60 percent
Water Table Depth:
>200 cm
(>80 inches)

Flooding:

Frequency: None
Duration: None

Ponding:

Frequency: None

Duration: None

Aspect: 25-160-290

Table 2. Representative physiographic features

Landforms	(1) Plateau > Hillslope (2) Mountains > Mountain slope (3) Plateau > Canyon
Flooding frequency	None
Ponding frequency	None
Elevation	815–1,044 m
Slope	30–60%
Aspect	W, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	None
Ponding frequency	None
Elevation	475–1,274 m
Slope	0–100%

Climatic features

Climatic Features
During the spring and summer, a circulation of air around a high-pressure center brings a prevailing westerly and northwesterly flow of comparatively dry, cool, and stable air into the region. As the air moves inland, it becomes warmer and drier, which results in a dry season beginning in the late spring and reaching a peak in mid-summer. In the fall and winter, a circulation of air around two pressure centers over the ocean brings a prevailing southwesterly and westerly flow of air into the Pacific Northwest. This air from over the ocean is moist and near the temperature of the water. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains or highlands. This results in a wet season that begins in October, reaches a peak in winter, then gradually decreases in the spring.

The elevation within the LRU varies from approximately 1,500 feet in the lower river valleys to over 7,000 feet in the higher terrain. The annual precipitation increases from 12 inches in the valleys to over 52 inches over the higher mountains. Winter season snowfall varies from 30 to 50 inches. Both rainfall and snowfall increase in the higher elevations. Snow can be expected after the first of November and to remain on the ground from the first of December until March or April.

In January, the average maximum temperature is near 31°F and the minimum temperature is 18°F. Minimum temperatures from -10°F to -20°F are recorded almost every winter and temperatures ranging to -30°F have been recorded. In July, the average maximum temperature is 85°F to 90°F and the minimum temperature is 45°F to 50°F. Maximum temperatures reach 100°F on a few afternoons each summer and temperatures between 105°F to 110°F have been recorded. Temperatures in the mountains decrease three to five degrees Fahrenheit with each 1,000 feet increase in elevation. The average date of the last freezing temperatures can be expected by mid-May and before mid-October in the warmer areas.
(Compiled from WRCC: Climate of Washington and available station data)
Frost-free period (days):
Total range = 85 to 130 days
Central tendency = 90 to 115 days

Mean annual precipitation (cm):
Total range = 370 to 550 mm
(15 to 22 inches)

Central tendency = 410 to 465 mm
(16 to 18 inches)
MAAT (C)
Total range = 7.4 to 10.4
(45 to 51 F)
Central tendency = 8.3 to 9.1
(47 to 48 F)

Climate stations: none

Table 4. Representative climatic features

Frost-free period (characteristic range)	90-115 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	406-457 mm
Frost-free period (actual range)	85-130 days
Freeze-free period (actual range)	
Precipitation total (actual range)	381-559 mm
Frost-free period (average)	100 days
Freeze-free period (average)	
Precipitation total (average)	432 mm

Influencing water features

There are no water features associated with this ecological site.

Soil features

Representative Soil Features
This ecological site is associated with several soil components (Klicker, Larabee, Porch, Tamming, and Wintercanyon). The soil components can be grouped into Pachic Ultic Argixerolls, Vitrandic Argixerolls, Lithic Ultic Haploxerolls, and Vitrandic Haploxerolls. These soils have developed in colluvium and/or residuum from basalt or metamorphic rock with thin layers of mixed tephra and loess.

Parent Materials:
Kind: Tephra (volcanic ash)
Origin: mixed
Kind: loess
Origin: mixed
Kind: residuum and colluvium
Origin: Basalt, Metasedimentary, or Metavolcanic rock

Surface Texture: (<2mm fraction)
(1) Ashy Silt Loam
(2) Ashy Sandy Loam
(3) Silt Loam

Surface Fragments

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Residuum–basalt (3) Colluvium–basalt (4) Residuum–metavolcanics (5) Colluvium–metavolcanics
Surface texture	(1) Ashy silt loam (2) Ashy sandy loam (3) Silt loam
Drainage class	Well drained
Permeability class	Moderate
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	7.87 cm
Calcium carbonate equivalent (0-152.4cm)	0%
Soil reaction (1:1 water) (25.4-152.4cm)	6.3
Subsurface fragment volume <=3" (25.4-152.4cm)	20%
Subsurface fragment volume >3" (25.4-152.4cm)	15%

Table 6. Representative soil features (actual values)

Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–0.1%
Available water capacity (0-101.6cm)	7.62–15.75 cm
Calcium carbonate equivalent (0-152.4cm)	0%
Soil reaction (1:1 water) (25.4-152.4cm)	5–7.3
Subsurface fragment volume <=3" (25.4-152.4cm)	10–40%
Subsurface fragment volume >3" (25.4-152.4cm)	5–25%

Ecological dynamics

ECOLOGICAL DYNAMICS OF THE SITE
This ecological site is located on forested backslope foothills, mountains and canyon side slopes along the tributary drainages of the Snake River. Ponderosa pine (*Pinus ponderosa*) is the predominant forested conifer species of this ecological site, occurring in early and mid-seral phases, as well as in the “climax” ecological phase. Limited occurrences of other tree species can be found on microsite positions across the larger landscape.
Upland forests of this ecological site are very warm and dry and exist in an ecotone position that is transitional between hotter and drier grasslands and shrublands, and cooler and moister forests that can support increasing amounts of Douglas-fir (*Pseudotsuga menziesii*), Grand fir (*Abies grandis*), and Western larch (*Larix occidentalis*). The primary disturbance regime that maintained this ecological site in the historical context was fire, which resulted (in the conifer portion of the vegetation) in multiple age (and size) classes. In the early successional states, the

ecological site is comprised of seedlings, saplings, and poles, which progress in time to older age and size classes of dominant/co-dominant and mature/over-mature stands of trees. Disturbance events are likely to occur at any successional stage. These forests are typically un-even aged and are shaped largely by surface and mixed severity fires. On a larger scale, this ESD is characterized overall by a heterogeneous spatial pattern across the landscape and includes numerous un-stocked various sized “patch” openings that are occupied by grass and shrub species, with or without recruitment of Ponderosa pine seedlings.
The most common historic fire disturbance, surface fires (also called ground fires), burned with a low intensity due to relatively small amounts of accumulated fuels. Surface fires occurred frequently, with an average return interval of less than 10 years. These fires served as a natural thinning agent for clumpy groups of young pine, providing positive benefits to the sapling and smaller pole size classes. The fire stimulated a self-pruning response as trees aged, reducing this specific source of ladder fuels. The repetitive pattern of various sized patch openings across the landscape limited the potential spread of crown fires when they did occur. Mixed severity fires, fires in which parts of the fire were lethal to the overstory and parts were not, were less common than surface fires, and true stand replacement fires were rare. (Note that current stand conditions in this ecological site do not, in most instances, conform to the historic range of variability (HRV) in terms of the expected frequency and severity of future wildfire events. This is further discussed in the Alternative State narratives).

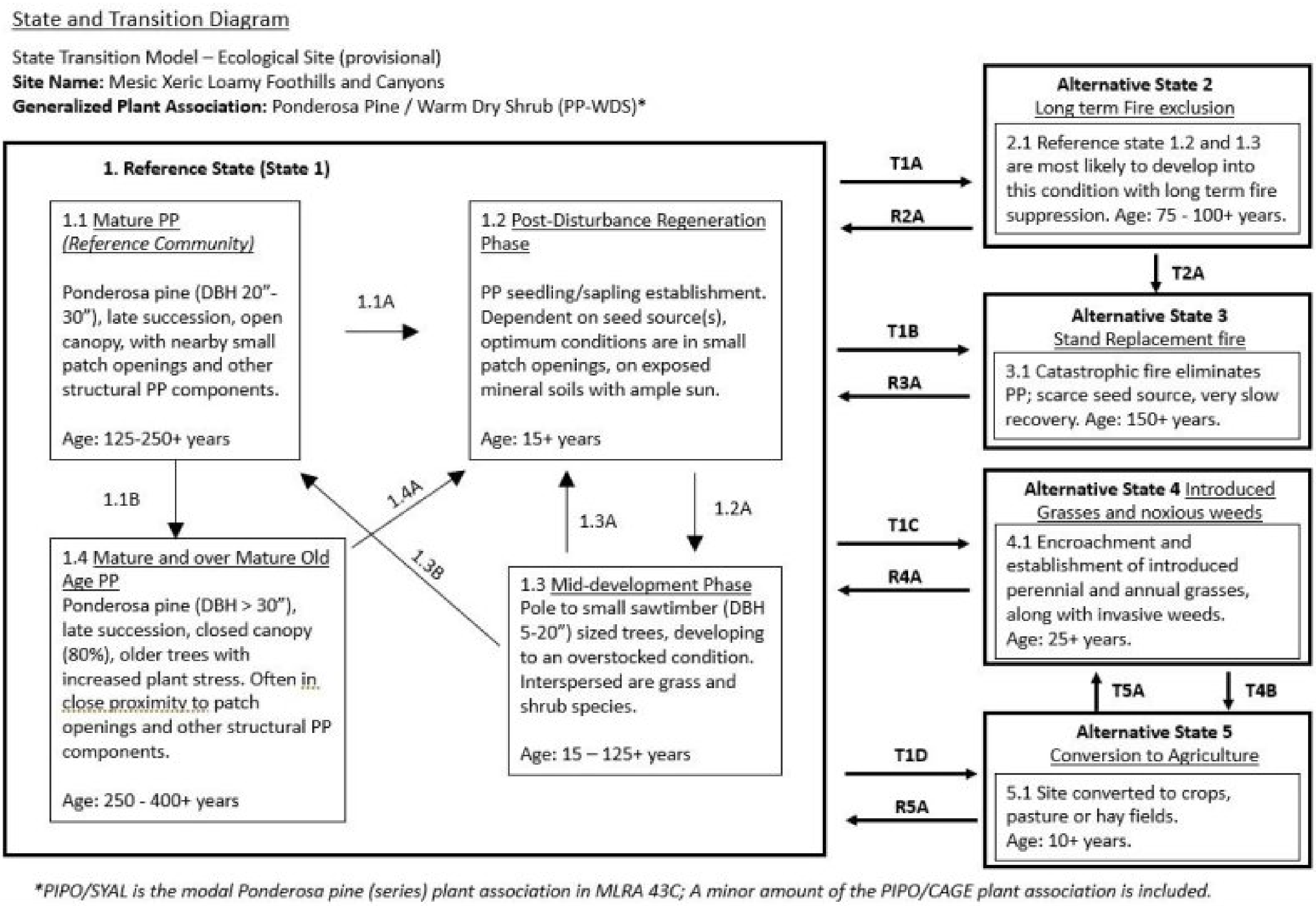
The historic understory vegetation community was conditioned to frequent fire disturbances, responding and recovering with a variety of adaptive strategies. Surface fires would create areas of exposed mineral soils which are a prerequisite for the initial seedling establishment of Ponderosa pine.

Naturally occurring fires were caused by late summer lighting strikes, but many fires were also deliberately ignited by indigenous tribes. Human-caused fires, which were commonly expressed as surface fires, were typically ignited in late spring or early fall. These fires were ignited to alter the understory plant community to achieve a variety of outcomes.

In addition to direct impacts of wildfire, disturbance factors that resulted in the death of mature pine included injury from lightning strikes, wind events, weather extremes, and the collective influence of various damage agents such as bark beetles, pine engraver, mistletoe, and other adapted insects and diseases associated with injury or competitive stressors.

The long-term perpetuation of this driest of all conifer forest type in MLRA 43C depends on the successful regeneration of Ponderosa pine as seedlings, some of which eventually grow to provide replacement for the mature component of overstory pine within the stand. Pine recruitment is limited to a short dispersal distance away from the seed tree source because the seed is relatively heavy. Viable seed crops occur intermittently, and a succession of favorable growing season conditions is required for a new cohort of pine to develop. Ponderosa pine recruitment can be a tenuous process, but this is offset to a large degree by the longevity attribute of the species.

State and transition model



State 1
Reference State - Ponderosa pine/grass savanna

The reference state has a variable but predictable plant expression across the landscape. In the larger context, these forests tended to be heterogeneous and spatially complex. A wide array of wildlife species benefited from the edge effects created by the spatial intersections within the larger landscape, and by naturally occurring snags and large woody debris. The Ponderosa pine forest is comprised of pure, self-replacing stands that function under the ecological parameters that were described in the section entitled "Ecological Dynamics of the Site." Fire is the most important disturbance agent in this reference state of the ecological site. The fire regime of the historic reference community phase is summarized as follows: Fire Regime Group Fire Interval (years) I 6 Replacement Mixed Low Fire Severity (%—probability of occurrence) 5 18 77 Range of Fire Return Interval (MFRI- years) >100 – 400+ 50-80 2-30 Average Fire Return Interval (AFRI – years) 125 35 8 Source: BpS model 910531 and FEIS "Fire Regime/Blue Mountains" publication. Across the overall landscape stand structure was expressed by a combination of patch openings, clumpy (dense or overstocked) tree groups, and as well-spaced mature overstory trees encompassing larger stand groups. These mosaic patterns could occur over the landscapes in a scale of upwards of tens of thousands of acres. Disturbances from fire and other biotic and abiotic sources impacted much smaller areas within the larger landscape, on the order of thousands of acres. Following a disturbance occurrence that eliminated or significantly reduced much of the established Ponderosa pine within the forest stand, the key to re-establishing and sustaining the reference state was dependent on the successful recruitment of Ponderosa pine seedlings from adjacent sources, from soil banked viable seed, or from remnant surviving seed trees. Larger sized patches and impacted areas approaching landscape level scales, isolated from seed sources and devoid of remnant Ponderosa pine of any size class, tend to revert to long term grass/shrub conditions. When the understory was impacted by wildfire (with or without overstory impacts), fire adapted species responded well following a light to moderate severity fire impact at the surface. Bluebunch wheatgrass, pine grass and elk sedge usually survived and were rejuvenated by the surface. Spirea, fireweed and limited amounts of common snowberry and bitterbrush all increase following these events. The reference plant community was a mature pine/shrub-grass savanna. The various common successional stages are shown on the state and transition diagram. Those conditions occur in shifting locations across the overall larger landscape, at various scales, over long periods of time.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- common snowberry (*Symphoricarpos albus*), shrub
- creeping barberry (*Mahonia repens*), shrub
- white spirea (*Spiraea betulifolia*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Idaho fescue (*Festuca idahoensis*), grass

Community 1.1
Mature Ponderosa pine (Reference Plant Community)

Figure 1. Mature Ponderosa pine (Reference Plant Community) Phase 1.1

This mid to late-seral phase is the dominant representation of the pre-European historic reference state which is sustained by plant adaptations to naturally occurring and frequent non-lethal fires. It is typically un-even aged.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
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- Idaho fescue (*Festuca idahoensis*), grass

Community 1.2
Post Disturbance Regeneration Phase

Figure 2. Scattered natural regeneration of Ponderosa pine seedlings. These seedlings are very vulnerable to mortality if another of the frequently occurring ground fires destroys them while they are small and susceptible.

Pine seedlings/saplings establish in small-size patch openings created from disturbance events (fire and disease or insect outbreaks, occurring in both endemic or epidemic outbreaks) that reduced or eliminated portions of the overstory canopy layer. Seedling recruitment commonly comes from seed production in the years following the event, but also from viable banked seed that was on the ground before the disturbance occurred or from surviving regeneration that pre-dated the disturbance. Favorable weather conditions are necessary for seedlings to establish and develop. Limitations of seed dispersion distance from seed trees (these are heavy seeds) seriously hinder Ponderosa pine re-establishment in larger patch sizes. Ponderosa pine seedlings will become established underneath overstory Ponderosa pine canopy layers, but their development and successional pathway will be impacted by the competition and shade relationships of the overstory stand. (Ponderosa pine is a “shade intolerant” tree species. This is a silvicultural term which means that the tree species is best adapted to growing in open sites or very low levels of overstory shade – Ponderosa pine is a “sun loving” conifer species).

Community 1.3
Mid –Development, Closed Phase

Figure 3. Dense or “clumpy” patch of Ponderosa pine poles and small sawtimber sized stems. This stand is in the stem exclusion phase. Since ground fires have not occurred on this site for a long period of time, no beneficial thinning has occurred.

The stand reaches the size class(s) of poles to small sawtimber size individuals (5 – 20” DBH). At this stage, Ponderosa pine is well suited to survive low intensity surface fire. The canopy will begin to close and understory early seral shrub cover, if present, begins to decline as tree canopy cover approaches 50%. In the transition phase between the sapling and pole-size class, understory fires begin to facilitate a beneficial “thinning” effect in dense stocking conditions (i.e., some trees succumb to the fire while others survive). In other instances, the stand will exhibit clumpy attributes, and increased intraspecific stand stress will occur as the stand ages, which is the beginning of the stem exclusion phase of stand development. Reoccurring ground fire near the middle and later stages of this phase can provide beneficial self-pruning of the lower limbs of individual trees, which reduces the subsequent ladder fuel risk for those trees.

Community 1.4
Late –Development, Closed Phase

Figure 4. Late –Development, Closed Phase – Plant Community Phase 1.4

Over a longer period of time an older stand has developed as described in pathway 1.1B. Along the way, large individual Ponderosa pine has succumbed to various disturbance agents such as western pine beetle, lightning strikes, and wind breakage, leading to mortality. The density of trees has continuously been reduced. At the same time, tree diameter(s) have continued to expand as stocking/density stressors continue to influence the stand. Persistent snags and the development of down wood is at an optimum level. Beneath the dominant and co-dominant overstory layer, a limited expression of younger cohorts of Ponderosa pine can exist. This phase will exhibit the characteristics of an “old growth” stand as it progresses and remains intact over time.

Pathway 1.1B
Community 1.1 to 1.2

Mature Ponderosa pine (Reference Plant Community)

Post Disturbance Regeneration Phase

Small scale patch openings are created by biotic and abiotic disturbances that reduced the structure and nature of the mature tree canopy layer. With time and the absence of major disturbance events, the stand develops into a mature/ over-mature cohort. The threat of mountain pine beetle increases, and individual trees within the canopy are at greater risk of insect and disease mortality which in turn create gaps in the overstory. Additional sunlight will reach the surface and impact the vegetation at that location.

Pathway 1.1C
Community 1.1 to 1.4

Mature Ponderosa pine (Reference Plant Community)

Late –Development, Closed Phase

Stand continues to progress in age with corresponding diameter increase. Forest plant competition increases in the over-mature overstory.

Pathway 1.2B
Community 1.2 to 1.3

Post Disturbance Regeneration Phase

Mid –Development, Closed Phase

Seedlings and saplings grow and develop to pole and small sawtimer size class(s). The stand develops relatively intact and grows from seedling/sapling to pole/small sawtimer size classes.

Pathway 1.3B
Community 1.3 to 1.1

Mid –Development, Closed Phase

Mature Ponderosa pine (Reference Plant Community)

Stand grows to the mature/large sawtimber phase (> 20” DBH). The stand develops to the mature phase. Stands have thinned as size classes increased, primarily from the natural exclusion processes as well as from stress induced bark beetle mortality (chiefly mountain pine beetle).

Pathway 1.3A
Community 1.3 to 1.2

Mid –Development, Closed Phase

Post Disturbance Regeneration Phase

Sapling and pole size young stand is killed by wildfire event. Fires occur which are severe enough to eliminate most of all Ponderosa pine size classes, and again sets back the development of the site to the regeneration phase.

State 2
Long Term Fire Exclusion

Conditions favorable to the development of this alternative state began to occur within the Reference State around the turn of the twentieth century. The impacts of fire exclusion, a management goal of post-European settlers, allowed many stands to progress without the natural occurrence of fire, especially frequently occurring and beneficial fire episodes. Fire suppression shifted the age expression and density of the younger stands, and changed the composition of understory vegetation, leading to reduced spatial variation. Fuel levels and fuel stratum layers increased, shifting the fire regime/condition class toward a greater likelihood of stand replacement fire episodes.

State 3
Stand Replacement Fire

This state represents conditions immediately following a catastrophic wildfire event. Long term detrimental impacts to wildlife, hydrology and soil quality occur immediately due to the abnormally high intensity of the catastrophic burn. Microbial populations, organic matter levels, and other structural elements of the native soil resources are negatively impacted. The number of wildlife snags will usually increase in the short term following the fire.

State 4
Introduced grasses and noxious weeds

This state developed with the introduction and invasion of introduced grasses and noxious weeds, most notably cheatgrass. These conditions were more likely to develop on areas which were near developed farm and pasture lands, and other converted lands.

State 5
Conversion to Agriculture

Characteristics and indicators. This state results from human intervention beginning with a very intensive or total harvest of the mature overstory, followed by stump removal and the elimination of all other native forest vegetation. Cultivation follows. These sites were often referred to as “cut over farm lands”. In this state virtually all the natural forest functions were eliminated by the conversion to agricultural land use (including annually tilled crops as well as hay and pasture production).

Transition T1A
State 1 to 2

Long term fire exclusion (50-100+) years (resulting in Alternative State 2).

Transition T1B
State 1 to 3

A wide spread catastrophic (also referred to as “stand replacing”) fire event occurs as a natural (but rare) event in the reference state. Ponderosa pine is virtually eliminated across all age/size classes, leading to a long-term deficiency of seed source to re-establishment Ponderosa pine (resulting in Alternative State 3).

Transition T1C
State 1 to 4

Introduced cool season grasses invading sites near homesteads, pastureland, and other converted land. This includes cheatgrass invasion of overgrazed sites, as well as other excessive disturbance(s) of the native vegetation (resulting in Alternative State 4).

Transition T1D
State 1 to 5

Site converted to annual cropland or pasture/hayland (leading to Alternative State 5).

Restoration pathway R2A
State 2 to 1

Treatment practices commonly used to rehabilitate forest lands and reduce fuels are applied. Practices include thinning and pruning, and associated practices as needed. Restoration practices that reduce excessive fuel loads and reduce overstory crown bulk density, as well as treatment of overstocked clumpy areas, are beneficial. Tree planting in larger, un-stocked areas where Ponderosa pine and other native seed sources are absent, as well as the introduction of prescribed burning, can contribute to increased resiliency and a return to natural ecologic integrity.

Transition T2A
State 2 to 3

Wide spread catastrophic fire occurs, similar to that of T1B, but the intensity and impact of the wildfire event is much greater in scope due to the unnatural buildup of fuels in Alternative State 2 (resulting as well to Alternative State 3).

Restoration pathway R3A

State 3 to 1

Ponderosa pine is planted due to the widespread lack of adequate seed source or surviving Ponderosa pine of any size or age class. Natural recovery will be extremely long without tree planning efforts, up to many 100's of years as Ponderosa pine would have to slowly re-establish parameter areas and then migrate inwards by natural reproduction under favorable circumstances. It is likely that persistent brush or grass/brush cover would exist for years if un-planted. Soil quality (e.g. soil microbial populations and nutrient cycling) is slow to respond to pre-fire levels, especially with the lack woody debris and other contributors to soil health.

Restoration pathway R4A
State 4 to 1

Site preparation and reseeding with native forest vegetation is practiced on sites that had been converted and managed in non-forest condition for a long period of time. (This process is referred to as afforestation). Practices that enable the site to revert to native understory species, for example tree and/or native grass planting in properly prepared seedbed conditions, have the potential to restore the function of native Ponderosa pine communities in this ecological site.

Transition R4B
State 4 to 5

Areas that were converted to cropland and had transitioned to introduced grasses and noxious weeds are once again properly treated to re-establish viable cropland, pasture or hayland. Practices are applied which eliminate unwanted weeds and invasive species, followed by the application of sound agronomic practices or by applying pasture/hayland management. Returns to Alternative State 5, and not to the Reference State.

Restoration pathway R5A
State 5 to 1

Efforts like those described in Restoration Pathway 4A are needed in order to restore these areas to conditions found in the Reference State. Site preparation and reseeding with native forest vegetation is on sites that had been converted and managed in non-forest condition for a long period of time. (This process is referred to as afforestation). Practices that enable the site to revert to native understory species, for example tree and/or native grass planting in properly prepared seedbed conditions, have the potential to restore the function of native Ponderosa pine communities in this ecological site.

Restoration pathway T5A
State 5 to 4

Poor management or abandonment leads to weed invasion, often with noxious species (resulting in Alternative State 4).

Additional community tables

Wood products

Production Interpretations of the PIPO/SYAL Reference State:

Site index (SI) is a common unit of measure for forest trees and stands. Site index and the resulting derivation of the Culmination of Mean Annual Increment (CMAI) are different indicators of site quality, serving as well as a proxy for the yield potential and for the general economic rotation age of a site. It is a simple measure of the age and height of dominant and co-dominant trees, usually referenced at 50 or at 100 years of age (called the "base age"). Additional information on SI and CMAI are provided in the table shown immediately below.

Ponderosa pine is the only commercial tree species in this ecological site. Site index value ranges depend on local soil-site characteristics. The combination of these soil-site characteristics is recognized within the defined attributes of established NRCS forested soil series and phases.

NRCS forest site index plots were taken in past years for 12 different suitable PIPO/SYAL type sites. The sample plots were located on non-federal lands across the geographic range of MLRA 43C.

Reineke's Stand Density Index (SDI) is another indexed system which is commonly utilized as an indicator of site quality. SDI is often used to obtain productivity and stocking projections. NRCS does not include specific SDI interpretations for the forested soils identified in a soil survey area, although a relative SDI value could be calculated from the raw field data.

SDI expresses stand density (the number of trees per unit area) at a standard average dbh (the diameter at breast height, 4 ½ feet above the ground surface). In the English system, SDI is indexed at a dbh of 10 inches, as derived from the quadratic mean diameter (QMD: the diameter of the tree of arithmetic mean basal area). Maximum density (Max SDI) is the theoretical biological carrying capacity of the site. Stocking guides can be developed from density parameters in order to manage for future desired conditions, specific to defined management objectives. In most cases the objective is a sustainable production of wood products. Stocking guidelines are normally expressed at the "full stocking" or "normal density" SDI level, which is approximately 80% of the stocking density defined as the Max SDI for the site.

Silvicultural and other useful plant interpretations have been researched and published by the Forest Service in this MLRA (primarily by the Umatilla National Forest). These technical references are useful in the development of the warm dry shrub Ponderosa Pine ecological site description.

A more recent production metric is the "Culmination of Mean Annual Increment" (CMAI) which is defined on page 7 of SIL-5. The CMAI yield capability estimations for various tree species measured within associated UNF plant associations is given in subsequent tables of this same reference. The NRCS uses CMAI to project yield estimations for forested soil series (and tree species) identified in a soil survey. CMAI values are associated with NRCS calculated SI values from sample plots. NRCS identifies the year at which the CMAI occurs for any given soil series and tree species.
Stand Density Index (SDI), Max SD, Full Stocking, UZ and LZ are best defined in Powell in the referenced white papers.

Other products

Herbage and Forage Estimations:

The total herbage production for the PIPO/SYAL plant association (measured from sample plots used to support the "Plant Associations of the Blue and Ochoco Mountains" publication) ranged from 175 to 1,500 pounds/acre, air dried. The average value for 16 samples plots is 582 pounds/acre, air dried.

Information collected during the development of the "Plant Associations of the Wallowa-Snake Province" indicate that the PIPO/SYAL plant association produced an average of 600 pounds/acre, air dried annual herbage in the study area. Two thirds of the annual herbage amount came from bunchgrass (forage) production, according to that publication.

Total herbage production, and especially forage production, will vary significantly depending on canopy coverage and the recent fire occurrence(s) on any given site, in addition to the annual variance attributed primarily to precipitation and temperature.

Table 7. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
ponderosa pine	*PIPO*	79	84	68	75	40	–	–	

References

. USNVC [United States National Vegetation Classification]. 2019. United States National Vegetation Classification

Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC.. USNVC: http://usnvc.org/.

. 2015. Ecological Systems of Washington State. A Guide to Identification .

Agee, J.K. 1993. Fire Ecology of Pacific Northwest Forests.

Arno, S. 2000. Fire in western forest ecosystems. in Wildland fire in ecosystems: effects of fire on flora. USDA Forest Service, General Technical Report RMRS-GTR-42-vol 2..

Churchill, D.J., G.C. Carnwath, A.J. Larson, and S.A. Jeronimo. 2017. Historical forest structure, composition and spatial pattern in dry conifer forests of the western Blue Mountains, Oregon. Gen. Tech. Rep. PNW-GTR-956.. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Cochran, P.H., J.M. Geist, D.L. Clemens, R.R. Clausnitzer, and D.C. Powell. 1994. Suggested Stocking Levels for Forest Stands in Northeastern Oregon and Southeastern Washington. Research Note PNW-RN-513.. U.S. Department of Agriculture, Forest Service, Bend, OR.

Crane, M.F. and W.C. Fischer. 1986. Fire ecology of the forest habitat types of central Idaho. Gen. Tech. Rep. INT-218.. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT.

Fitzgerald, S.A. 2005. Fire Ecology of Ponderosa Pine and the Rebuilding of Fire-Resilient Ponderosa Pine Ecosystems. Pages 197–225 in Proceedings of the Symposium on Ponderosa Pine: Issues, Trends, and Management, Gen. Tech. Rep. PSW-GTR-198.. Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, Albany, CA.

Graham, R.T. and T.B. Jain. 2005. Ponderosa Pine Ecosystems. Pages 1–32 in Proceedings of the Symposium on Ponderosa Pine: Issues, Trends, and Management, Gen. Tech. Rep. PSW-GTR-198.. Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, Albany, CA.

Hall, F.C., L. Bryant, R. Clausnitzer, and et al. 1995. Definitions and Codes of Seral Status and Structure of Vegetation. General Technical Report PNW-GTR-363.. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

Johnson Jr, C.G. and R.R. Clausnitzer. 1992. Plant Association of the Blue and Ochoco Mountains. Tech. Publ. R6-ERW-TP-036-92.. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Wallow-Whitman National Forest, Portland, OR.

Johnson, C.G. and S.A. Simon. 1987. Plant Association of the Walla-Snake Province, Wallowa-Whitman National Forest. R6-ECOL-TP-225A-86.. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Wallow-Whitman National Forest.

Juran, A.G. 2017. Juran, Ashley G. 2017. Fire regimes of conifer forests in the Blue Mountains. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory (Producer)..

Larson, A.J. and D.C. Churchill. 2012. Tree spatial patterns in fire-frequent forests of western North America, including mechanisms of pattern formation and implications for designing fuel reduction and restoration treatments. Forest Ecology and Management 267:74–92.

McDonald, G.I., A.E. Harvey, and J.R. Tonn. 2000. Fire, Competition and Forest Pests: Landscape Treatment to Sustain Ecosystem Function. Pages 165–211 in Proceedings from the Joint Fire Science Conference and Workshop: crossing the millennium: integrating spatial technologies and ecological principles for a new age in fire management; the Grove Hotel, Boise, Idaho, June 15-17, 1999.. University of Idaho, Moscow, Idaho.

McDonald, G.L., A.E. Harvey, and J.R. Tonn. 2000. Fire, Competition, and Forest Pests: Landscape Treatment to Sustain Ecosystem Functions, The Joint Fire Science Conference and Workshop.. Pages 195–211 in Proceedings from the Joint Fire Science Conference and Workshop: crossing the millennium: integrating spatial technologies and ecological principles for a new age in fire management.

Mehl, C.A. and et al. 1998. The Ecosystem Diversity Matrix for the Idaho Southern Batholith Landscape: A User's Manual. Wildlife & Ecosystems Management Associates for the Boise Cascade Corporation..

Powell. 1996(rev 2012). A Stage is a Stage is a Stage … Or Is It? White Paper F14-SO-WP-Silv-10. Pendleton, OR. U.S. Department of Agriculture, Forest Service, Umatilla National Forest..

Powell. 2006(rev 2014). Updates of Maximum Stand Density Index and Site Index for the Blue Mountains Variant of the Forest Vegetation Simulator. White Paper F14-SO-WP-Silv-39.. U.S. Department of Agriculture, Forest Service, Umatilla National Forest, Pendleton, OR.

Powell. 2010(rev 20141). Site Productivity Estimates for Upland Forest Plant Associations of the Blue and Ochoco Mountains. White Paper F14-SO-WP-Silv-5.. U.S. Department of Agriculture, Forest Service, Umatilla National Forest, Pendleton, OR.

Powell, D.C. 2006 (rev 2017). Seral Status for Tree Species of the Blue and Ochoco Mountains. Tech. Publ. F14-SO-WP-SILV-58.. Department of Agriculture, Forest Service, Pacific Northwest Region, Umatilla National Forest, Pendleton, OR. U.S..

Powell, D.C., C.G. Johnson, E.A. Crowe, A. Wells, and D.K. Swanson. 2007. Potential vegetation hierarchy for the Blue Mountains section of northeastern Oregon, southeastern Washington, and west-central Idaho. Gen. Tech. Rep. PNW-GTR-709.. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station., Portland, OR.

Staddon, W.J., L.C. Duchesne, and J.T. Trevors. 1999. The role of microbial indicators of soil quality in ecological forest management. For. Chron. 81–86.

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Approval

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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	06/02/2024
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):**

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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:

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

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

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

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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:**

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17. **Perennial plant reproductive capability:**
