10541

Southern Rocky Mountain Ponderosa Pine Woodland - South

BpS Model/Description Version: Aug. 2020

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| --- | --- | --- | --- |
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Vegetation Type

Forest and Woodland

Map Zone

27

Model Splits or Lumps

This Biophysical Setting (BpS) is split into multiple models. This BpS is split into a northern and southern version to represent differences in regimes and covers and rocky nature. The northern version is found north of ECOMAP subsections M331Ii (Cleland et al. 2007), and the southern version is found south of subsection M331Ii on rocky soils. This southern model is to only represent the PIPO Woodland on very rocky soils/terrain in New Mexico.

Geographic Range

The only places this system doesn't occur in map zones (MZs) 27 and 33 1054 southern version in New Mexico are in ECOMAP subsections 315Ab, 315Ba, and 315Bd. In MZs 27 and 33 southern CO version, it would be in subsections M331Fa, M331Fb,a,c,f, and 331Ii. (above from M331Ii, it wouldn't be this type -- would be more like Rocky Mountain PIPO types -- more granitic and northern version of MZs 27 and 33 1054).

Biophysical Site Description

In New Mexico portion, 6,500-7,500ft (slightly lower than model 1117) in ridges, canyons, mountain sideslopes, and mesatops.

In New Mexico, mean annual precipitation is 16-18in in MZ27. BpS is best described as a woodland that has *Pinus ponderosa*.

Soils are moderate (loams to heavy sandy loams) to moderately fine (includes clay loams and light clays). This has stones, rocks, and cobbles on the soil surface and below the soil surface. That is what separates this system from the savannas -- i.e., very rocky.

Growing-season moisture is through monsoonal (mid-July through mid-September) thunderstorms. Also has winter snowpack. So moisture is bimodal -- some in summer, some in winter.

This ecological system generally occurs on igneous, metamorphic, and soils derived from sedimentary material, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, rockiness, and periods of drought during the growing season.

*Pinus ponderosa* is a drought-resistant, shade-intolerant conifer, which usually occurs at lower treeline in the major ranges

Vegetation Description

*Pinus ponderosa* (primarily var. *scopulorum* and var. *brachyptera*) is the predominant conifer; *Pinus edulis* and *Juniperus* spp. may be present in the tree canopy. The horizontal and vertical diversity of this system was high, with ponderosa pine occurring in multi-storied conditions and open canopies of 10-30% total tree canopy cover.

The understory can be shrubby, with *Cercocarpus montanus*, *Purshia tridentata*, *Quercus gambelii*, *Symphoricarpos* spp., and *Rosa* spp. common species.

*Pascopyrum smithii* and species of *Hesperostipa*, *Achnatherum*, *Festuca*, *Muhlenbergia*, and *Bouteloua* are some of the common grasses.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIPO | *Pinus ponderosa* | Ponderosa pine |
| NAVI4 | *Nassella viridula* | Green needlegrass |
| FEAR2 | *Festuca arizonica* | Arizona fescue |
| QUGA | *Quercus gambelii* | Gambel oak |
| PIED | *Pinus edulis* | Twoneedle pinyon |
| JUSC2 | *Juniperus scopulorum* | Rocky mountain juniper |
| MUMO | *Muhlenbergia montana* | Mountain muhly |
| CEMO2 | *Cercocarpus montanus* | Alderleaf mountain mahogany |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

This system is characterized by frequent surface fires, localized mortality, and multi-storied (multi-aged) conditions (Swetnam and Baisan 1996; Sneed et al. 2002; Fule et al. 2003). Localized mixed-severity fires also maintained these woodlands, depending on climate, degree of soil development, and understory density. Mean surface fire intervals are estimated to be 10-30yrs. Infrequent stand-replacement fires occur on the order of several hundred years.

Historically, surface fires and drought were influential in maintaining open-canopy conditions in these woodlands. Pre-settlement fire regimes were primarily frequent, low-intensity ground fires triggered by lightning strikes or deliberately set fires by Native Americans. With fire suppression and increased fuel loads, fire regimes are now less frequent and often become intense crown fires, which can kill mature *Pinus ponderosa* (Reid et al. 1999).

Establishment is erratic and believed to be linked to periods of adequate soil moisture and good seed crops, as well as periodic fire frequencies, which allow seedlings to reach sapling size. Mehl (1992) states the following: "Where fire has been present, occurrences will be climax and contain groups of large, old trees with little understory vegetation or down woody material and few occurring dead trees. The age difference of the groups of trees would be large. . . ."

Drought and other weather events (e.g., blowdown), parasites, and disease apparently played a minor role in the development of forest structure in this system. However, insects could have been a significant, frequent occurrence. Mortality by insect and disease agents occurred on a localized level, particularly where there were older or more stressed and susceptible individuals. Drought causes trees to be susceptible to insect outbreak. Inappropriate tree spacing (due to lack of fire in current conditions) allows beetles to move from tree to tree.

In a dry series of years during drought, at the lower elevation limit of this BpS, pinyon-juniper will move upslope.

Effects of native grazing were probably insignificant in this system.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 348 | 3 |  |  |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) | 12 | 97 |  |  |
| All Fires | 11 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

This BpS occurs as broad, long bands in 100s to few thousand acres. It also occurs on mesatops and sideslopes.

The disturbances occur in a more patchy distribution, the bulk of the area expressed in uneven-aged conditions.

Adjacency or Identification Concerns

In Colorado -- north of ECOMAP subsection M331Ii -- wouldn't be this type. It would be more like Rocky Mountain PIPO types -- more granitic.

A century of anthropogenic disturbance and fire suppression has resulted in a higher density of *Pinus ponderosa* trees, altering the fire regime and species composition. (This doesn't happen as often in MZ27 New Mexico.)

With settlement and subsequent fire suppression, ponderosa pine stands have become denser (not as much in MZ27 New Mexico -- although this would happen in BpS 1117). Presently, some occurrences contain understories of more shade-tolerant species, including younger cohorts of *Pinus ponderosa*. This is an encroachment, fire-suppression state -- not occurring historically. These altered occurrence structures have affected fuel loads and alter fire regimes. Pre-settlement fire regimes were primarily frequent (5-30yr return intervals), low-intensity ground fires triggered by lightning strikes or deliberately set fires by Native Americans. With fire suppression and increased fuel loads, fire regimes are now less frequent and often become intense crown fires, which can kill mature *Pinus ponderosa* (Reid et al. 1999).

Longer fire return intervals (FRIs) have resulted in many occurrences having dense subcanopies of overstocked and unhealthy young *Pinus ponderosa* (Reid et al. 1999).

Fire suppression has allowed the canopy of ponderosa pine to close, causing a decline in understory herbaceous vegetation.

The majority of ponderosa pine woodlands in the southwest historically were open and multi-storied due to the site potential and the high frequency of surface fires.

There is probably some pinyon-juniper and oak encroachment in this system due to fire suppression.

This system can easily be mistaken for BpS 1117 Pine Savanna, although total tree cover was historically higher. This system (1054) can also be distinguished by rock outcrop, stones, and cobbles in and above the surface. BpS 1117 typically occurs more on mountain toeslopes, whereas 1054 occurs on lower montane slopes, mesatops, canyons, and sidewalls. This 1054 system is also distinguished by higher shrub cover and more of a shrub component. Tree spacing should be wider in 1117 historically; however, presently you might not be able to distinguish because 1117 is more closed due to fire suppression.

This BpS is an isolated island BpS. Surrounded by shortgrass prairie. This is not surrounded by the other forest types -- not a gradient. This system could also occur adjacent to some pinyon-juniper systems. It also could be adjacent to riparian systems such as BpS 1155.

Grace's warbler, pygmy nuthatch, and flammulated owl are indicators of a healthy ponderosa pine woodland. All of these birds prefer mature trees in an open woodland setting (Winn 1998; Jones 1998; Levad 1998 as cited in Rondeau 2001).

Original modelers for MZ27 felt that this BpS overall in New Mexico MZ27 should not be departed from reference condition state, due to the rocky, remote nature.

Issues or Problems

This southern version of 1054 for MZs 27 and 33 is thought to be different than the northern version, which is more similar to a Rocky Mountain version. The canopy covers in this model differ quite a bit from other PIPO Woodland models. There was disagreement as to whether or not that was a valid difference. Therefore, this split is to just refer to the rocky site PIPO in New Mexico.

Native Uncharacteristic Conditions

Over 50% canopy cover would be uncharacteristic in this rocky-site type of PIPO Woodland

Comments

This model for BpS 1054 for MZs 27 and 33 was adapted from a draft model from MZ27 BpS 1117 drafted by John Tunberg, Rex Pieper, Clarence Chavez, and Lee Elliott.

Draft model for MZ27 BpS 1117 was adapted from a draft model from MZs 27 and 33 BpS 1117 drafted by Allen Gallamore and Herman Garcia, which was adapted from model from MZ28 for BpS 1117 created by Jeff Redders, Patrick Medina, and an anonymous modeler, and reviewed by Brenda Willmore, Laurie Huckaby, and an anonymous reviewer.

Model for MZ28 1117 based on the Rapid Assessment model R3PPGRsw by J. Redders (jredders@fs.fed.us), P. Medina (pmedina@fs.fed.us), and an anonymous modeler. Original model reviewed by Brenda Wilmore (bwilmore@fs.fed.us).

Additional reviewers of BpS for MZ28 include Paul Langowski (plangowski@fs.fed.us), Dick Edwards (rledwards@fs.fed.us), Vic Ecklund (vecklund@csu.org), and Chuck Kostecka.

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | A | A | A | A | A | UN | UN | UN | UN | UN |
| Tree | 5-10 | B | B | B | C | C | UN | UN | UN | UN | UN |
| Tree | 10-25 | B | B | B | C | C | UN | UN | UN | UN | UN |
| Tree | 25-50 | D | D | D | D | E | UN | UN | UN | UN | UN |
| Tree | >50 | D | D | D | D | E | UN | UN | UN | UN | UN |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 12 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| NAVI4 | Nassella viridula | Green needlegrass | Lower |
| QUGA | Quercus gambelii | Gambel oak | Middle |
| PIPO | Pinus ponderosa | Ponderosa pine | All |
| CEMO2 | Cercocarpus montanus | Alderleaf mountain mahogany | Middle |

Description

Bunchgrass-dominated. Dominant lifeform will be herbaceous, with <50% canopy cover and height of 0.4m. Most of the ground will be litter and bare ground and rock. Annual forbs come in right after fire but do not last for a long time. Some ponderosa pine individuals also becoming established. Establishment has been historically episodic in many locations around the west, and there are likely lags in timing of recruitment (Teague 2004). Typically, 2-3yrs of above-average moisture will get the seedlings started.

There will be fire in this stage that will, over time, cull out some of the ponderosa pine seedlings. Low-severity fire occurs because trees are the overstory. Drought (modeled as wind/weather/ stress) would open up areas -- could then be subject to pinyon-juniper invasion. Seedling recruitment of PIPO would decrease during drought. Alternate succession could take this class to the closed mid development stage -- based on where seedlings have sprouted up -- in rockier areas or not.

*Maximum Tree Size Class*  
Seedling <4.5ft

Class B 2 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| NAVI4 | Nassella viridula | Green needlegrass | Lower |
| QUGA | Quercus gambelii | Gambel oak | Middle |
| CEMO2 | Cercocarpus montanus | Alderleaf mountain mahogany | Middle |

Description

Small and medium-sized ponderosa pine, with moderate bunchgrass cover. Dominant lifeform will be herbaceous, with canopy cover up to 50% cover and height of 1m. Some settings exhibited scattered oak motts. This is the highest producing stage for the herbaceous vegetation. Resistant to erosion by wind and water in this class as well. This is also the best water-producing stage for springs and seeps.

There will be maintenance fires on a periodic basis (every 10-15yrs), which will suppress ponderosa pine regeneration and pinyon-juniper invasion and algerita expansion. (Currently, that is occurring without active management.). The trees that have established in this class in recent decades have escaped the effects of the maintenance fires. Maintenance low-severity fires and nutrient cycling actually enhance growth in this class and therefore accelerate succession. Thus, alternate succession was also modeled with a probability similar to low-severity fires. Replacement fires occurred rarely.

Insect and disease incidence favors open canopy conditions but does not cause a state change. Drought has less impact than in savanna because of large rocks that concentrate water to roots of trees.

*Maximum Tree Size Class*  
Medium 9-21" DBH

Class C 10 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| QUGA | Quercus gambelii | Gambel oak | Middle |
| CEMO2 | Cercocarpus montanus | Alderleaf mountain mahogany | Middle |
| BOGR2 | Bouteloua gracilis | Blue grama | Lower |

Description

Small and medium-sized ponderosa pine. This is a "closed" stage but still not completely closed due to the rocky nature. This class occurs due to stony nature of soil, wider spacing of vegetation -- doesn't get as much fire influence -- doesn't carry fire as well. So more densely stocked, more disease-prone trees. Becomes stagnant more quickly. This becomes even more prominent in the late development stage.

*Maximum Tree Size Class*  
Medium 9-21" DBH

Class D 73 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| QUGA | Quercus gambelii | Gambel oak | Middle |
| CEMO2 | Cercocarpus montanus | Alderleaf mountain mahogany | Middle |
| HECO26 | Hesperostipa comata | Needle and thread | Lower |

Description

This class represents the end stage of gap succession where frequent maintenance fires continue to cycle nutrients. Large and very large old ponderosa pine overtopped a medium-high cover of bunchgrasses or, on some settings, shrubs. Old-growth attributes included occasional down wood, snags, and diseased trees. Disease more prevalent in mature stands. Maintenance burns still occurring. Catastrophic replacement fires, if present, occurred on extremely long intervals.

The proportion of the late-open class would presumably be higher than any mixed conifer system due to the frequency of surface fire and the rarity of stand-replacement fire. The majority of ponderosa pine woodlands in the southwest were open and multi-storied due to the site potential and the high frequency of surface fires (Jack Triepke, USFS, personal communication).

This class was originally modeled by modelers with 41-50% cover as a "healthy" stage; however, that concept was questioned by others; cover was changed to 11-40% cover to be more consistent with models from other MZs.

*Maximum Tree Size Class*  
Large 21-33" DBH

Class E 3 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| QUGA | Quercus gambelii | Gambel oak | Middle |
| CEMO2 | Cercocarpus montanus | Alderleaf mountain mahogany | Middle |
| BOGR2 | Bouteloua gracilis | Blue grama | Lower |

Description

This class was originally modeled as a disclimax "unhealthy" stage >149yrs with lower cover, 31-40%, than the Class D other late stage. Original modelers stated the following: it was a late development stage but in the stage due to the rocky soils. The rocky soils don't allow the maintenance fires to carry through this stage; therefore, nutrients don't cycle, and weak/diseased trees stay in the system. There is slightly less canopy cover in this stage versus the other late development open stage. This difference is significant in terms of fire regime; therefore, even though canopy distinction is very small, the modelers decided to keep this stage.

However, because reviewers disagreed with that concept, that understanding of this class was rejected and changed cover was changed from 31-40% to 41-50%.

Due to lack of fire to redistribute nutrients, trees continue to accumulate available nutrients, moisture. Therefore, the understory herbaceous species are greatly diminished. Dead and downed material common on the ground.

*Maximum Tree Size Class*  
Large 21-33" DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:OPN | 50 |
| Mid1:CLS | 51 | Late1:CLS | 149 |
| Mid1:OPN | 51 | Late1:OPN | 149 |
| Late1:OPN | 150 | Late1:OPN | 999 |
| Late1:CLS | 150 | Late1:CLS | 999 |

Probabilistic Transitions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |
| Alternative Succession | Early1:ALL | Mid1:CLS | 0.01 | 100 | Yes | 0 |
| Wind or Weather or Stress | Early1:ALL | Early1:ALL | 0.02 | 50 | No | 0 |
| Surface Fire | Early1:ALL | Early1:ALL | 0.1 | 10 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Wind or Weather or Stress | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Insects or Disease | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.083 | 12 | No | 0 |
| Alternative Succession | Mid1:OPN | Late1:OPN | 0.083 | 12 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Wind or Weather or Stress | Mid1:CLS | Mid1:CLS | 0.01 | 100 | No | 0 |
| Insects or Disease | Mid1:CLS | Mid1:CLS | 0.01 | 100 | No | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Wind or Weather or Stress | Late1:OPN | Late1:OPN | 0.01 | 100 | No | 0 |
| Insects or Disease | Late1:OPN | Late1:OPN | 0.067 | 15 | No | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.1 | 10 | No | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Late1:CLS | 0.01 | 100 | No | 0 |
| Insects or Disease | Late1:CLS | Late1:CLS | 0.01 | 100 | No | 0 |
| Surface Fire | Late1:CLS | Late1:OPN | 0.02 | 50 | Yes | 0 |

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