10510

Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland

BpS Model/Description Version: Aug. 2020

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

Forest and Woodland

Map Zone

27

Geographic Range

Occurs throughout the southern Rockies, into New Mexico and Arizona, and north and west into Arizona, Utah, Nevada, western Wyoming, and Idaho. Minor occurrence in map zone (MZ) 25 with significantly different composition. In MZ27 in New Mexico, this type is thought to occur only on lower montane slopes of the Manzano, Manzanita, and Sandia ranges. Within MZ27, it occurs in New Mexico in ECOMAP section M313.

Biophysical Site Description

This type is located just above sagebrush ecosystems (not in southwest) and adjacent to or above ponderosa pine woodlands or forests. These mixed-conifer forests occur on all aspects (north and east aspects are treated in Biophysical Setting (BpS) 1052 at elevations ranging from 1,200-3,300m (or 2,450-2,900m in NM). Rainfall averages <75cm per year (40-70cm) with summer "monsoons" during the growing season contributing substantial moisture. The composition and structure of overstory is dependent upon the moisture relationships of the site and successional status.

Mixed conifer in the southwest had highly diverse stand composition and stand structure. This diversity was largely driven by topography, with the scale of stands dependent on the scale of topographic variation. Ridge tops and low-elevation sites were (and largely still are) characterized by open stands dominated by ponderosa pine and had frequent surface fires. South- and west-facing slopes likely were similar but were less open and had less ponderosa and more Douglas-fir, aspen, and white fir. These stands likely also were characterized by frequent surface fires. Perhaps the core of BpS 1051 resembles these stands. North- and east-facing slopes were likely denser and had still less ponderosa and more white fir, as well as Engelmann spruce and subalpine fir, especially at higher elevations. Perhaps the core of BpS 1052 resembles these stands. Valley bottoms, if forested and not 1146, had dense stands similar to BpS 1055 and 1056, dominated by blue spruce, Engelmann spruce, subalpine fir, and aspen. BpS 1054, 1055, 1056, 1051, and 1052 made up the mixed-conifer landscape in which stands were connected by various ecological processes (John Vankat, personal communication). See White and Vankat (1993), Fule et al. (2003), Vankat (2005), etc.

Vegetation Description

Mixed conifer in the southwest had highly diverse stand composition and stand structure. Ridge tops and low-elevation sites were (and largely still are) characterized by open stands dominated by ponderosa pine. South- and west-facing slopes likely were similar but were less open and had less ponderosa and more Douglas-fir, aspen, and white fir. Perhaps the core of BpS 1051 resembles these stands. North- and east-facing slopes were likely more dense and had still less ponderosa and more white fir, as well as Engelmann spruce and subalpine fir, especially at higher elevations. Perhaps the core of BpS 1052 resembles these stands. Valley bottoms, if forested and not BpS 1146, had dense stands similar to BpS 1055 and 1056, dominated by blue spruce, Engelmann spruce, subalpine fir, and aspen (John Vankat, personal communication).

*Pseudotsuga menziesii* and *Abies concolor* are frequent, but *Pinus ponderosa* may be present to co-dominant. *Pseudotsuga menziesii* tends to dominate drier sites where *Pinus ponderosa* is a common co-dominant. *Abies concolor* tends to dominate cooler sites, such as upper slopes at higher elevations, canyon sideslopes, ridge tops, and north- and east-facing slopes, which burn somewhat infrequently. *Picea pungens* is most often found in cold, moister locations, often occurring as smaller patches or frost bands within a matrix of other associations. As many as seven conifers can be found growing in the same stand. There are a number of cold-deciduous shrub and graminoid species that are common to these forests, including *Mahonia repens* (although this is not cold-deciduous), *Symphoricarpos oreophilus*, *Jamesia americana*, and *Festuca arizonica*.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PSEUD7 | *Pseudotsuga* | Douglas-fir |
| ABCO | *Abies concolor* | White fir |
| PIPO | *Pinus ponderosa* | Ponderosa pine |
| POTR5 | *Populus tremuloides* | Quaking aspen |
| PIEN | *Picea engelmannii* | Engelmann spruce |

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

Disturbance Description

Surface and mixed-severity fires were characteristic. Surface fire intervals ranged from 10-50yrs, and replacement-severity occurred at intervals of 150-400yrs+ (Crane 1986; Barrett 1988; Bradley 1992a and 1992b; Brown 1994; Morgan et al. 1996). Mixed-severity fires were assumed to have an intermediate return interval of 45-75yrs on average. Less specific information is available to mixed-conifer forests of the southwest. Stand-replacement fires were generally restricted to the closed canopy forest and the stand initiation conditions and extreme fire seasons. In the southwest, stand-replacement fires were apparently rare and limited in spatial extent (Grissino-Mayer et al. 1995; Allen et al. 2002; Fule et al. 2003; Vankat 2005). Note that for MZ27, some of the fire return intervals for fires in the successional class boxes were changed to match this description better and to be more consistent with the rest of the MZ and adjacent MZs. Mean fire return intervals (MFRIs) were lengthened slightly.

The high-frequency, low- and mixed-severity fire regime characteristics were facilitated by understory vegetation dominated by fine fuel (grasses, sedges, and forbs), landscape position, and adjacency to other frequent fire BpSs. Much of the forest structure was open canopy overstory that resulted in an understory dominated by healthy and vigorous plants (grasses, sedges, and forbs) and generally continuous fine fuel layer. These fine fuels facilitated fire spread and thinning of the conifer or aspen seedlings (thus promoting aspen suckering).

Aspen patches occurred at smaller scales than in moister mixed-conifer forests. These more mesic sites would have had grass understories that did not cure as early in the year as surrounding areas, especially under a closed forest canopy, and these mesic areas often experience quicker humidity recovery in the evenings. These circumstances tended to lessen the fire severity in the aspen stands, which acted as fire-safe sites compared to the surrounding landscape. This was important because aspen is much less resistant to fire than Douglas-fir. Greater suckering would occur at the edges of aspen patches.

Other disturbances include insect, disease, drought, and wind and ice damage.

In the southwest, western spruce budworm outbreaks were estimated to occur on the order of every three decades and affected small portions of the mixed-conifer zone (Swetnam 1987; Lynch and Swetnam 1992; Swetnam and Lynch 1993).

Competition among trees was also a factor that increasingly slowed successional dynamics in more closed stands. Fire was by far the dominant disturbance agent.

Mixed-conifer types in the southwest had highly diverse stand composition, stand structure, and probably, fire regime. This diversity was largely driven by topography, with the scale of stands dependent on the scale of topographic variation. Ridge tops and low-elevation sites were (and largely still are) characterized by open stands dominated by ponderosa pine and had frequent surface fires. South- and west-facing slopes likely were similar but were less open and had less ponderosa and more Douglas-fir, aspen, and white fir. These stands likely also were characterized by frequent surface fires. Perhaps the core of BpS 1051 resembles these stands. North- and east-facing slopes were likely more dense and had still less ponderosa and more white fir, as well as Engelmann spruce and subalpine fir, especially at higher elevations. These stands likely had less frequent surface fires and occasional crown fires. Perhaps the core of BpS 1052 resembles these stands. Valley bottoms, if forested and not BpS 1146, had dense stands similar to BpS 1055 and 1056, dominated by blue spruce, Engelmann spruce, subalpine fir, and aspen. These stands likely had less frequent surface fires and occasional crown fires. BpS 1054, 1055, 1056, 1051, and 1052 made up the mixed-conifer landscape in which stands were connected by various ecological processes, especially the mixed-severity fire regime (John Vankat, personal communication). See White and Vankat (1993), Fule et al. (2003), Vankat (2005), etc.

Moderate fire frequencies, along with occasional insect or disease outbreaks, would favor relatively open, late successional forest conditions. Due to adjacency or terrain, stands in the southwest would have often been multi-storied and dominated by ponderosa pine. Due mainly to fire suppression, contemporary stands are often closed and vulnerable to high-severity fire.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 277 | 7 | 150 | 600 |
| Moderate (Mixed) | 56 | 34 | 45 | 75 |
| Low (Surface) | 33 | 59 | 10 | 50 |
| All Fires | 19 | 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 in patches ranging from 100s-1,000s of acres. Mixed-severity fire favored the development of intermediate-sized patches.

Adjacency or Identification Concerns

If aspen is present in large patches or if conifers are not coming in after ~30yrs, the BpS is probably misclassified, and one of the pure aspen types should be examined (Rocky Mountain Aspen Forest and Woodland or Intermountain Basins Aspen-Mixed Conifer Forest and Woodland).

BpS is often between non-forested areas (stands of 1146) or between *Pinus ponderosa* at lower elevations and spruce-fir at higher elevations.

This type is generally located just above sagebrush ecosystems adjacent to ponderosa pine woodlands.

In the southwest, ridge tops and low-elevation sites were (and largely still are) characterized by open stands dominated by ponderosa pine and had frequent surface fires. This could therefore be confused for 1054 or PIPO models. This type could also be confused for 1055 and 1056, the spruce-fir types as well as the aspen types. This could also easily be confused for 1052.

There are conditions and uncharacteristic patterns that wouldn't have existed under the HRV -- such as areas of heterogeneous topography where large-scale, homogeneous crown fires have burned topographic positions formerly characterized by surface fires.

Also, many stands (especially at higher elevations) have recently undergone dramatic insect-related mortality. It is questionable whether this thinning represents a natural cycle or has been promoted by global climate warming.

Today, there would be much larger patches of crown fires occurring, therefore creating landscapes with greatly reduced heterogeneity. There would be greater abundance of white fir. Prior to the recent insect-related mortality, stands were likely denser and more homogeneous because of fire exclusion today.

Exotics are present but generally not abundant.

Issues or Problems

Native Uncharacteristic Conditions

Patches of crown fire today exceed patch scale of topography. Today, there would be much larger patches of crown fires occurring, therefore creating landscapes with greatly reduced heterogeneity. There would be greater abundance of white fir. Prior to the recent insect-related mortality, stands were likely denser and more homogeneous because of fire exclusion today.

Moderate fire frequencies, along with occasional insect or disease outbreaks, would favor relatively open, late successional forest conditions. Due to adjacency or terrain, stands in the southwest would have often been multi-storied and dominated by ponderosa pine. Due mainly to fire suppression, contemporary stands are often closed and vulnerable to high-severity fire.

Comments

This model for MZ27 was adapted from the same BpS from MZ25. Description modified to reflect southwest for MZ27. Some of the MFRIs changed for consistency with text and adjacent MZs and other systems within MZ27, based on MZ27 review. Therefore, modeler names were changed to the reviewers.

For MZ25, 151051 was imported as is from MZ15. Minor vegetation edits were made.

151051 was created by Mark Loewen, Doug Page, Linda Chappell. Based on the Rapid Assessment model R2PSMEdy (original modeler Lynn Bennett, lmbennett@fs.fed.us, and modified by Louis Provencher). Hugh Safford (hughsafford@fs.fed.us) and Steve Barrett (sbarrett@mtdig.net) were reviewers of R2PSMEdy.

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 | A | A | A | A | A |
| Tree | 5-10 | C | C | C | B | B | B | B | B | B | B |
| Tree | 10-25 | D | D | D | E | E | E | E | E | E | E |
| Tree | 25-50 | D | D | D | E | E | E | E | E | E | E |
| Tree | >50 | D | D | D | E | E | E | E | E | E | E |

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 15 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CARU | Calamagrostis rubescens | Pinegrass | Low-Mid |
| CAGA3 | Carex garberi | Elk sedge | Low-Mid |
| PSEUD7 | Pseudotsuga | Douglas-fir | Upper |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |

Description

Grass/forb/shrub/tree seedlings. Replacement fire was originally modeled as being frequent (MFRI of 25yrs), and mixed-severity fire was originally modeled with an MFRI of 100yrs. However, because that would increase the replacement fire overall MFRI and because the upper layer is trees, this was changed. Instead, mixed-severity fire was modeled to be interpreted as a combination of low and replacement (in grass) fire.

POTR5 can also be in this class.

*Maximum Tree Size Class*  
Sapling >4.5ft; <5" DBH

Class B 8 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PSEUD7 | Pseudotsuga | Douglas-fir | Upper |
| ABCO | Abies concolor | White fir | Upper |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| PICO | Pinus contorta | Lodgepole pine | Upper |

Description

Closed stand with trees, poles, saplings, grass, and scattered shrub, 75-100% Douglas-fir and/or white fir.

*Maximum Tree Size Class*  
Pole 5-9" DBH

Class C 14 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PSEUD7 | Pseudotsuga | Douglas-fir | Upper |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Mid-Upper |

Description

Open trees (poles and saplings) of Douglas-fir and occasional ponderosa pine with grass and scattered shrubs.

*Maximum Tree Size Class*  
Pole 5-9" DBH

Class D 60 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PSEUD7 | Pseudotsuga | Douglas-fir | Upper |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Mid-Upper |

Description

Open large tree/grass and scattered shrubs; Douglas-fir with occasional ponderosa pine.

The amount of this class was questioned by a reviewer for MZ27. Reviewer thought that mixed conifer might show a larger percentage in mid-development classes.

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

Class E 3 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PSEUD7 | Pseudotsuga | Douglas-fir | Upper |
| ABCO | Abies concolor | White fir | Upper |
| PICO | Pinus contorta | Lodgepole pine | Upper |
| PIPO | Pinus ponderosa | Ponderosa pine | Middle |

Description

Closed large trees of Douglas-fir, white fir, and scattered shrubs.

*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:CLS | 34 |
| Mid1:OPN | 35 | Late1:OPN | 104 |
| Mid1:CLS | 35 | Late1:CLS | 104 |
| Late1:OPN | 105 | Late1:OPN | 999 |
| Late1:CLS | 105 | 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** |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.01 | 100 | Yes | 0 |
| Mixed Fire | Early1:ALL | Early1:ALL | 0.04 | 25 | No | 0 |
| Alternative Succession | Mid1:OPN | Late1:CLS | 1 | 1 | Yes | 68 |
| Wind or Weather or Stress | Mid1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.0025 | 400 | Yes | 0 |
| Competition or Maintenance | Mid1:OPN | Mid1:OPN | 0.005 | 200 | No | 0 |
| Insects or Disease | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.013 | 77 | No | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.04 | 25 | No | 0 |
| Wind or Weather or Stress | Mid1:CLS | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Insects or Disease | Mid1:CLS | Mid1:OPN | 0.01 | 100 | Yes | 0 |
| Competition or Maintenance | Mid1:CLS | Mid1:CLS | 0.01 | 100 | No | 0 |
| Mixed Fire | Mid1:CLS | Mid1:OPN | 0.02 | 50 | Yes | 0 |
| Alternative Succession | Late1:OPN | Late1:CLS | 1 | 1 | Yes | 70 |
| Competition or Maintenance | Late1:OPN | Late1:OPN | 0.001 | 1000 | No | 0 |
| Wind or Weather or Stress | Late1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Insects or Disease | Late1:OPN | Late1:OPN | 0.01 | 100 | No | 0 |
| Mixed Fire | Late1:OPN | Late1:OPN | 0.013 | 77 | No | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.04 | 25 | No | 0 |
| Wind or Weather or Stress | Late1:CLS | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.0067 | 149 | Yes | 0 |
| Insects or Disease | Late1:CLS | Mid1:OPN | 0.01 | 100 | Yes | 0 |
| Insects or Disease | Late1:CLS | Late1:OPN | 0.01 | 100 | Yes | 0 |
| Competition or Maintenance | Late1:CLS | Late1:CLS | 0.01 | 100 | No | 0 |
| Surface Fire | Late1:CLS | Late1:CLS | 0.02 | 50 | No | 0 |
| Mixed Fire | Late1:CLS | Late1:OPN | 0.0222 | 45 | Yes | 0 |

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