11660

Middle Rocky Mountain Montane Douglas-fir Forest and Woodland

BpS Model/Description Version: Aug. 2020

|  |  |  |  |
| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
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| None | None | Anonymous | None |

Reviewer: Daniel Donato

Vegetation Type

Forest and Woodland

Map Zone

21

Geographic Range

This Biophysical Setting (BpS) is the most common low-elevation forest type in the Greater Yellowstone Ecosystem and occurs across eastern Idaho, southwestern Montana, and northwestern Wyoming.

Biophysical Site Description

Douglas-fir forests occupy a broad elevational range, between the limber pine type and grasslands/shrublands on lower foothills and the cool/dry subalpine vegetation types. This BpS often occurs at higher elevations on slopes with southern aspects where it can be co-dominant with whitebark pine or limber pine. Slopes with northern aspects tend to be more mesic and can support a mixed conifer community including a number of subalpine tree species. This can also occur in the mid-elevation ranges (6,000-8,000ft) in southwestern Wyoming.

Vegetation Description

Generally dominated by *Pseudotsuga menziesii* with an understory of graminoids, shrubs, and/or other conifer species. Shrub cover varies from sparse to dense and typically includes *Symphoricarpos* spp., *Physocarpus malvaceus*, *Juniperus communis*, *Artemesia tridentata* var. *vaseyana*, and *Holodiscus discolor*. Co-dominant species include *Pinus flexilis*, *Juniperus scopulorum*, and *Populus tremuloides* at lower elevations and lodgepole pine (*Pinus contorta* var. *latifolia*), subalpine fir (*Abies bifolia*), Engelmann spruce (*Picea engelmanii*), and whitebark pine (*Pinus albicaulis*) at higher elevations. Composition can vary widely based on disturbance history and site conditions. Stand structure ranges from young even-age stands to multiple age class old-growth stands to sparsely treed open parklands and woodlands.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PSME | *Pseudotsuga menziesii* | Douglas-fir |
| PICO | *Pinus contorta* | Lodgepole pine |
| POTR5 | *Populus tremuloides* | Quaking aspen |
| SYAL | *Symphoricarpos albus* | Common snowberry |
| SYOR | *Symphoricarpos orbiculatus* | Coralberry |
| PHMA5 | *Physocarpus malvaceus* | Mallow ninebark |
| BERE2 | *Begonia reniformis* | Grapeleaf begonia |
| CAGE | *Carex geophila* | White mountain sedge |

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

Disturbance Description

Fire regime is predominantly mixed-severity with a mean fire return interval (MFRI) of ~20-84yrs (Arno and Gruell 1983; Barrett 1994; Fischer and Clayton 1983; Houston 1973; Korb et al. in preparation; Littell 2002; Naficy et al. 2015). Mixed-severity fires are generally characterized by spatially heterogeneous burning that results in a complex and dynamic mosaic of low-severity surface fires and high-severity surface or crown fires. Large, stand-replacing fire occurs to a lesser degree, mostly in dense stands and/or with severe fire weather. Arno and Gruell (1983) and Barrett (1994) described frequent surface fires along a Douglas-fir-grass/shrub ecotone. Naficy et al. (2015) characterized the fire regime at a Douglas-fir site north of Yellowstone N.P. as dominated by mixed-severity (defined as a mix of low, moderate or high severity) fires. There seems to be a general absence of fire in the last 100yrs (Arno and Gruell 1983; Houston 1973; Littell 2002), most likely due to successful fire suppression and livestock grazing.

One LANDFIRE National anonymous reviewer (personal correspondence) stated that MFRI for mixed-severity fire should not be 70yrs but rather 200yrs, using a CFI correction for Korb (in preparation). Korb (personal correspondence) states that the influence of small fires was removed by removing any fire dates that were recorded on <25% of samples. Therefore, when the same fire year is recorded on several scarred trees over a large area, it is assumed that the fire burned throughout most of that larger area. The interval for the 25% filter composite MFRI reported was 26-34yrs (with tremendous variability around those means) for the xeric and mesic types of 1166 respectively. Including all the small fires that did occur, any given point likely burned more frequently on average. Also, the composite MFRIs for the two study areas were 9yrs and 15yrs (xeric and mesic forests respectively), which, if a multiplier (Baker in press) of 4.0 is applied, results in "corrected" MFRIs of 36 and 60yrs (xeric and mesic).

As the anonymous reviewer is assuming lack of fire where scars are not found, Korb is assuming lack of historical record of the fires that did occur where scars are not found. An MFRI for mixed was chosen at 50, based on all stated above and original modelers' descriptions.

Some modelers proposed inclusion of low-severity fires into the model, at a low frequency. However, surface fires were not added into the model, as the consensus among other modelers and reviewers was that mixed fire captured any of the low-severity fire component and that more fire did not need to be modeled in this system.

The most common insects causing mortality include Douglas-fir bark beetle in Douglas-fir and mountain pine beetle in lodgepole pine. Medium to large trees are most susceptible although poles may be infrequently infected. Spruce budworm is present in pockets within the zone. While it often weakens Douglas-fir and may make them more susceptible to bark beetles, direct mortality from budworm is uncommon. The most common disease affecting older Douglas-fir stands is Schweinitzii.

Dwarf mistletoe might also be present on south-facing slopes, according to reviewers. However, in the Gallatin National Forest, dwarf mistletoe is not seen on south slopes or anywhere in the Douglas-fir system.

Wind/weather/stress may infrequently affect stands and were therefore given low probabilities.

The 20th century is moister than the 19th, which has affected disturbance conditions.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 295 | 14 | 200 | 300 |
| Moderate (Mixed) | 46 | 86 | 20 | 80 |
| Low (Surface) |  |  | 200 | 400 |
| All Fires | 40 | 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 type is dominated by mixed-severity fires. A disturbance such as fire tends to create numerous small patches (holes) within the stand due to the mortality often associated with mixed-severity fire. Fire sizes are generally variable but may be linked to time of season and available fuel. Patches of severe fire within pre-European settlement mixed-severity fire perimeters have been documented in western Greater Yellowstone Ecosystem to be generally <40ha in extent.

Adjacency or Identification Concerns

This BpS has gradual, fuzzy boundaries at its upper elevation boundary with subalpine forests and at its lower elevational boundary with aspen and sagebrush grasslands.

This BpS corresponds with cool, dry Douglas-fir and limber pine habitat types (Pfister et al. 1977), including PSME/CAGE, PSME/SYOR, PSME/SYAL, PSME/ARCO, PSME/PHMA, and PSME/JUCO.

This type often forms an ecotone with mountain grasslands/sagebrush. Class A in this model is equivalent with a Class A in neighboring grassland/shrubland types. Higher elevations of this type border subalpine fir systems and persistent lodgepole pine in frost pockets and cooler areas of the map zone (MZ).

Douglas-fir increases in canopy density in the absence of fire. Much of this landscape today has canopy cover denser than the historic range of variability.

The modelers and reviewers developed the BpS 1166 model with the intent to include all Douglas-fir-dominant forests in the Greater Yellowstone Ecosystem. Although there have been several fire history studies in the Douglas-fir forest type within the Greater Yellowstone Ecosystem, there is little information about variation in fire regimes and reference structure within the forest type. For this reason, it has been proposed that lumping all Douglas-fir forests in MZ21 is appropriate for this effort. Modelers and reviewers for MZ21 felt that BpS 1045 is not present in MZ21 and that this BpS 1166 should account for the Douglas-fir in this MZ. Most of the indicator species for 1045 do not occur in the northwestern part of the Greater Yellowstone Ecosystem.

Issues or Problems

Douglas-fir will often encroach from this BpS into adjacent shrublands or grasslands with fire exclusion and during moist climatic periods.

Native Uncharacteristic Conditions

Comments

Daniel Donato reviewed this model during the 2016 BpS Review. Donato noted that this BpS is lumping open dry parklands stands of Douglas-fir with dense, multi-story, quasi-subalpine Douglas-fir stands. This lumping probably obscures differences in fire regimes, but the reviewer commented that there was little information on which to base a model split. Future BpS refinement should consider splitting this BpS into finer units.

During the 2016 BpS Review Cameron Naficy, while not providing a full review, offered the following comment on this model: “For zone 21, our data indicate that there were some low severity fires and that stand-replacing fires were more frequent than the 300 year FIs in the existing models. Specific data will be available soon once our publications are out. I suspect the high stand replacement parameter estimate for these forests is based on the set of studies (e.g. Barrett et al. 1994, Houston 1973, Arno & Gruell 1983, Heyerdahl et al. 2006, Korb unpublished) in ecotonal Douglas fir forests that has found recurrent non stand-replacing fires at intervals of 30-50 years. These ecotonal forests are an important part of the ecology of Douglas fir forests in zone 21, but applying this model to non ecotonal Douglas fir forests, which probably occupy a greater percentage of the Douglas-fir cover type in this zone, is not appropriate. Estimates from some of these Douglas-fir forest may better represent FIs [fire intervals] from grasslands rather than non ecotonal Douglas-fir forests.” Once published data are available the fire parameters of this model should be revisited.

This BpS is mapped in MZs 9, 10, 19, 21, 22 and 29. In MZ19, LANDFIRE National modelers split out a fire-maintained subtype. During the 2016 BpS Review, Kori Blankenship asked reviewers if the fire-maintained subtype was found in other zones.

-One reviewer, familiar with MZs 9, 10 and 19, felt that if this type existed it could be found at the forest-grass/shrub ecotone. The reviewer noted that she had only observed it in MZ10 and that it may not warrant a separate model.

-Another reviewer felt that the subtype did exist in MZs 8, 9, 10 and 22 and was more common on southern and southwestern aspects.

-Cameron Naficy responded that in his study areas (manuscript in development) in Zone 21, he “documented very few low density, multi-cohort Douglas-fir stands resulting from repeated low severity fire, i.e. these stands occupied a small portion of the landscape.  Many of these stands were ecotonal with grasslands and seemed to be in topographic safe sites such as rocky outcrops, concave depressions or on soil types with little organic material. Some of these factors might help you map the distribution of this forest type, but the relatively fine scale of the effects I’m describing and their inconsistency (i.e. not all rocky outcrops or concave depressions have fire-maintained forest) would make this challenging. In zones 21 and 19, most of our multi-cohort Douglas-fir stands showed clear evidence of initiating following high severity fire, but were subsequently affected by a variable number of non stand-replacing wildfires. Thus, they were multi-cohort, but resulting from a mix of severities over time rather than repeated low severity fires. Our dataset paints a picture primarily of non equilibrium dynamics over time at the patch scale, meaning that most patches in our study areas experienced a mix of fire severities over time and there were likely state switches between forest/non forest conditions over time in portions of the forest-grassland ecotone. Overall, I’m not sure it’s accurate to invoke an equilibrium dynamics model to describe these stands as is implied by the fire-maintained label. Doing so, I think, misinterprets the dynamics and processes that likely characterized many relatively open Douglas-fir forests historically. Rather than creating a unique fire-maintained sub group for each zone, unless there is good evidence for the existence of those dynamics in a specific region, I think it’s more accurate to stick with a mixed severity model for most of these forests and work to try to refine the parameters.”

Since the feedback was inconclusive, Blankenship made no changes. This issue should be reconsidered for future model refinement efforts.

Quantitative and descriptive changes for MZ21 reflect the cooler and drier climate east of the continental divide. Other LANDFIRE National reviewers for MZ21 included Liz Davy (edavy@fs.fed.us), Tim Belton (tbelton@fs.fed.us), Heidi Whitlatch, David Barron (dbarron@fs.fed.us), Spencer Johnston (sjohnston@fs.fed.us), Candi Eighme (ceighme@fs.fed.us), and Lisa Heiser (lheiser@fs.fed.us).

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 | UN |
| Tree | 5-10 | C | C | C | C | B | B | B | B | B | UN |
| Tree | 10-25 | D | D | D | D | E | E | E | E | E | UN |
| Tree | 25-50 | D | D | D | D | E | E | E | E | E | UN |
| Tree | >50 | D | D | D | D | E | E | E | E | E | 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 7 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PSME | Pseudotsuga menziesii | Douglas-fir | Upper |
| PICO | Pinus contorta | Lodgepole pine | Upper |
| SYAL | Symphoricarpos albus | Common snowberry | Lower |
| CARU | Calamagrostis rubescens | Pinegrass | Lower |

Description

Dominated by graminoids and seedling/sapling Douglas-fir and possibly lodgepole pine. Understory may be dominated by *Calamagrostis rubescens* and/or *Carex* spp. Shrub species such as *Symphoricarpos* spp. may be present.

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

Class B 12 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PSME | Pseudotsuga menziesii | Douglas-fir | Upper |
| PICO | Pinus contorta | Lodgepole pine | Upper |
| SYAL | Symphoricarpos albus | Common snowberry | Lower |
| CARU | Calamagrostis rubescens | Pinegrass | Lower |

Description

Relatively dense pole and some medium Douglas-fir and possibly lodgepole pine. The understory is open and relatively depauperate. Understory may be dominated by *Calamagrostis rubescens* and/or *Carex* spp.

Although LANDFIRE National reviewers recommended removing insects/disease from this class, it was decided by Region 1 insect experts that some insect damage is likely for the Class B forest types. The insects to be concerned about at low levels are Douglas-fir pole beetle and western spruce budworm.

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

Class C 14 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PSME | Pseudotsuga menziesii | Douglas-fir | Upper |
| PICO | Pinus contorta | Lodgepole pine | Upper |
| SYAL | Symphoricarpos albus | Common snowberry | Lower |
| CARU | Calamagrostis rubescens | Pinegrass | Lower |

Description

Open pole and medium Douglas-fir that may have lodgepole pine with patchy graminoid cover and dispersed shrubs such as *Symphoricarpos* spp. Understory may be dominated by *Calamagrostis rubescens* and/or *Carex* spp. Conifer heights range between 5-20m but adjusted to eliminate class overlap.

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

Class D 47 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PSME | Pseudotsuga menziesii | Douglas-fir | Upper |
| PICO | Pinus contorta | Lodgepole pine | Upper |
| SYAL | Symphoricarpos albus | Common snowberry | Lower |
| CARU | Calamagrostis rubescens | Pinegrass | Lower |

Description

Open canopy of medium to large Douglas-fir with a graminoid and shrub understory with highly variable understory cover. Lodgepole pine may be present. Understory may be dominated by *Symphoricarpos* spp., *Calamagrostis rubescens*, and/or *Carex* spp. Heights can exceed 25m up to ~30m.

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

Class E 20 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PSME | Pseudotsuga menziesii | Douglas-fir | Upper |
| PICO | Pinus contorta | Lodgepole pine | Upper |
| SYAL | Symphoricarpos albus | Common snowberry | Lower |
| CARU | Calamagrostis rubescens | Pinegrass | Lower |

Description

Multi-storied Douglas-fir, sometimes with lodegpole pine present. Understory with variable cover often dominated by *Calamagrostis rubescens*, *Carex* spp., *Symphoricarpos* spp., and/or *Physocarpus malvaceous*. Heights can exceed 25m up to ~30m.

*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 | 40 |
| Mid1:CLS | 20 | Late1:CLS | 99 |
| Mid1:OPN | 40 | Late1:OPN | 99 |
| Late1:OPN | 99 | Late1:OPN | 999 |
| Late1:CLS | 100 | 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 | 1 | 1 | Yes | 20 |
| Wind or Weather or Stress | Early1:ALL | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Mixed Fire | Early1:ALL | Early1:ALL | 0.005 | 200 | No | 0 |
| Alternative Succession | Mid1:OPN | Mid1:CLS | 1 | 1 | Yes | 58 |
| Wind or Weather or Stress | Mid1:OPN | Mid1:OPN | 0.005 | 200 | No | 0 |
| Insects or Disease | Mid1:OPN | Mid1:OPN | 0.005 | 200 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.025 | 40 | No | 0 |
| Wind or Weather or Stress | Mid1:CLS | Mid1:OPN | 0.001 | 1000 | Yes | 0 |
| Insects or Disease | Mid1:CLS | Mid1:OPN | 0.005 | 200 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Mid1:CLS | Mid1:OPN | 0.02 | 50 | Yes | 0 |
| Alternative Succession | Late1:OPN | Late1:CLS | 1 | 1 | Yes | 45 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Wind or Weather or Stress | Late1:OPN | Late1:OPN | 0.008 | 125 | No | 0 |
| Mixed Fire | Late1:OPN | Late1:OPN | 0.02 | 50 | No | 0 |
| Insects or Disease | Late1:OPN | Late1:OPN | 0.1 | 10 | No | 0 |
| Wind or Weather or Stress | Late1:CLS | Late1:OPN | 0.005 | 200 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Insects or Disease | Late1:CLS | Late1:OPN | 0.01 | 100 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late1:OPN | 0.03 | 33 | Yes | 0 |

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