11791

Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna - Low Elevation Woodland

BpS Model/Description Version: Aug. 2020

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

Forest and Woodland

Map Zones

29, 30

Model Splits or Lumps

This Biophysical Setting (BpS) is lumped with 1013.

Geographic Range

This low-elevation ponderosa pine woodland and forest grows in the northern and central Black Hills on all aspects, below BpS 10480 and above BpS 11792. This woodland and forest type also occurs in areas surrounding the Black Hills, including southeastern Montana, northcentral Wyoming's Bighorn National Forest, and small portions of southwestern North Dakota and northwestern South Dakota. Includes Bull Mountains north of Billings -- northeastern quadrant of map zone (MZ) 29. This type would be in MZs 29 and 30. In MZ29, specifically in subsections 331Mi, 331Md, and 334Ab.

Biophysical Site Description

This BpS is found on all aspects of the Black Hills, below BpS 10480 and above BpS 11792 predominantly on the lower limestone plateau and material weathered from metamorphic rocks. Typically, this type is found at elevations ranging from ~4,000-6,000 feet (1,200-1,800 m) (Marriott et al. 2000). At these sites, ponderosa pine grows more densely and continuously than in the savanna type BpS 11792. Outside of the Black Hills, this type is found on north and northeast aspect slopes. Soils range from sandy loams to loams (Hansen and Hoffman 1988). The underlying substrate is predominantly sedimentary.

Vegetation Description

Ponderosa pine is the dominant species in this vegetation type. Other commonly associated trees include bur oak and Rocky Mountain juniper. Common shrubs include chokecherry, common juniper, common snowberry, creeping barberry, kinnikinnick, Saskatoon serviceberry, and white spirea. Common graminoids include poverty oatgrass, sedges, and roughleaf ricegrass (Marriott et al. 2000).

BpS Code 1013 Bur Oak is included in this model; 1013 occurs primarily in the northwestern Black Hills and Bearlodge although it can occur in occasionally throughout the BpS. For more information on this site, see Marriott et al. 2000.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIPO | *Pinus ponderosa* | Ponderosa pine |
| PRVI | *Prunus virginiana* | Chokecherry |
| QUMA2 | *Quercus macrocarpa* | Bur oak |
| ORAS | *Oryzopsis asperifolia* | Roughleaf ricegrass |
| JUCO6 | *Juniperus communis* | Common juniper |
| MARE11 | *Mahonia repens* | Creeping barberry |
| ARUV | *Arctostaphylos uva-ursi* | Kinnikinnick |

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

Disturbance Description

Fires were less frequent and severity more variable in these more mesic ponderosa pine woodlands and forests at higher elevations as compared to those in the lower-elevation ponderosa pine savanna (BpS 11792). In these communities, low- to moderate-severity surface fires occurred at ~10-22yr intervals, and high-severity, crown fires occurred infrequently (>100yr intervals) (Brown 2003; Brown and Sieg 1996; Brown et al. 2008; Wienk et al. 2004). See Murphy (2017) for a synthesis of fire regimes in the Black Hills region.

The presence of abundant fire-scarred trees in multi-aged stands supports a prevailing historical model for ponderosa pine forests in which recurrent surface fires affected heterogeneous forest structure (Brown 2006). Mixed-severity fire occurs if fire return intervals (FRIs) are missed and stand-replacement fire is infrequent. Some speculate that stand-replacing fire in the Black Hills is less frequent than outside. The Black Hills’ stand-replacement frequency is thought to be ~300yrs+. Some speculate that the stand-replacement frequency outside the Black Hills is thought to be ~150-200yrs (and is thought to be as such for the Laramie Peak area). With the Native American influence outside of the Black Hills, the replacement fire interval could be even more frequent than the 300yr interval. However, due to lack of evidence for a different interval outside of the Black Hills, the 300yr interval was chosen for this model and based on review.

There is considerable debate over the role of mixed-severity and surface fires in the historical range of variability in this and other ponderosa pine forests in the northern and central Rockies (Baker and Ehle 2001, 2003; Barrett 2004; Veblen et al. 2000).

Brown (in press) argues that surface fire was dominant mode of disturbance.

Snead (2005) reported a mean fire return interval of 4-42yrs on northern side of Ashland Ranger District; on southern side, 4-63yrs.

Precipitation is concentrated in April through June but occurs throughout the growing season, resulting in good pine regeneration and dense patches of saplings. Elk, and to a lesser extent, bison, were important ungulates. Windthrow, storm damage, and mountain pine beetles are important disturbances in this type, especially when stands reach high densities, as evidenced in mountain pine beetle outbreaks occurring from 2000 through present and still increasing (USDA Forest Service 2006 map).

Insect/disease disturbance occurs, but frequency is variable. It was modeled at a very infrequent rate. Frequency could be related to density; therefore, is modeled in the late closed and open stages. For additional information on insects in the Black Hills, see the Phase II Amendment (USDA Forest Service 2005).

Disturbance from mountain pine beetles (MPB) was frequent locally and rare area-wide. Current research indicates highest probability of infestation occurs in areas >120 sq ft per acre (possibly 100) of trees averaging 7in DBH or greater.

The occurrence of area-wide MPB epidemics is dependent on favorable weather and abundant food supplies in the form of adjacent susceptible areas.

In ponderosa pine, bur oak occurs with fire-adapted species. When a stand-replacing fire occurs, system will get big patches of bur oak that will persist until the pine comes in. Bur oak is moderately shade-intolerant (according to <https://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/summary_of/tree_characteristics.htm>).

In the northern Black Hills, there is a separate bur oak community type with a long FRI. However, because bur oak grows within many systems in this MZ, it was not modeled separately and is included in many of the systems.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 311 | 6 | 100 | 400 |
| Moderate (Mixed) | 267 | 7 | 50 | 400 |
| Low (Surface) | 20 | 87 | 5 | 50 |
| All Fires | 18 | 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

Disturbance patch size probably ranged from 10s-10,000s of acres.

In the Black Hills, system would have been 100s-10,000s of acres. Outside of the Black Hills, this BpS would have been 10s-1,000s of acres.

Adjacency or Identification Concerns

This type occurs at elevations above Ponderosa Pine Savanna (BpS 11792) and at elevations below Northwestern Great Plains Highland Spruce Woodland and Ponderosa Pine-Black Hills (BpS 2910480). This type differs from 10480 because it has been documented to have more frequent surface fires, less frequent replacement fires, and less closed-canopy forest (Brown 2003).

This system may be difficult to distinguish from 111792 Ponderosa Pine Savanna as they grow adjacently to each other. It could also be adjacent to grassland and shrubland systems or associated with prairie systems. It might also be adjacent to and intermingled with green ash/ woody draw systems. Ponderosa pine invasion has occurred at the lowest elevations along grassland margins. Elevation, in addition to plant species composition and density, may help distinguish these vegetation communities.

As this system model and description is a copy of 1054, this system will be difficult to distinguish from that one and is only distinguished by geography.

Increased ladder fuel because of missed fire cycles increases the probability of a stand-replacement fire.

The absence of dwarf mistletoe distinguishes this PIPO system from most others in the country.

This model for 11791 for MZ29 seems to differ slightly from 1054 in MZ20 (adjacent MZ), due to distinctness of Black Hills ponderosa pine. However, in general, overall FRI is similar with mostly low-severity fires. And general amounts in the successional classes are similar, with similar cover/height distinctions. Some of the other disturbance probabilities differ, due to more information provided in literature for MZ29.

In this system, as in many others, non-native grass species may be providing different surface fire effects. For example, litter produced by Kentucky bluegrass, Japanese brome, and downy brome is much finer and has different characteristics for burning, insulation, and moisture retention. This would change the effects of fires, even if they occurred at historic frequencies. The most likely change is in composition of surface vegetation, although longer-term effects to the soil may also occur.

Issues or Problems

Native Uncharacteristic Conditions

Currently, there have probably been at least five fire cycles that have been missed due to suppression, grazing, etc., in the Black Hills. Therefore, the system today would look much more like the late closed stage with ~70-90% canopy closure, at least in the Black Hills area.

Comments

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 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Herb | 0.5-1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Herb | >1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 0-0.5 | A | A | A | A | A | A | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | UN | UN | UN | UN |
| Shrub | >3.0 | A | A | A | A | A | A | UN | UN | UN | UN |
| Tree | 0-5 | C | C | C | C | C | B | B | B | B | B |
| Tree | 5-10 | C | C | C | C | C | B | B | B | B | B |
| Tree | 10-25 | D | D | D | D | D | E | E | E | E | E |
| Tree | 25-50 | D | D | D | D | D | E | E | E | E | E |
| Tree | >50 | D | D | D | D | D | 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 5 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PRVI | Prunus virginiana | Chokecherry | Mid-Upper |
| PIPO | Pinus ponderosa | Ponderosa pine | Middle |
| QUMA2 | Quercus macrocarpa | bur oak | Mid-Upper |

Description

Herbaceous/shrubby post-replacement class.

In Bear Lodge, this stage is dominated by bur oak. In the Black Hills lower limestone area, grasses/forbs dominate along with chokecherry, serviceberry, or rose often present. Bur oak is an indicator for the Black Hills but not for other areas.

Outside of the Black Hills, this community is associated with grass/forb, chokecherry, serviceberry, leadplant, raspberry, rose, creeping barberry, and snowberry.

Shrubs are typically >1m, but chokecherry can reach heights of >3m.

*Maximum Tree Size Class*  
Seedling <4.5ft

Class B 19 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |

Description

Pole ponderosa pine (dog hair). Very few understory species present due to canopy closure. This class may succeed to a late closed stage if not affected by fire or insect outbreaks.

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

Class C 13 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| PRVI | Prunus virginiana | Chokecherry | Middle |
| QUMA2 | Quercus macrocarpa | bur oak | Mid-Upper |

Description

Understory species would be similar to those in Class A. Snowberry will also become more prevalent. Grasses could include roughleaf ricegrass in Black Hills.

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

Class D 54 Late Development 1 - Open

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: 0 - 50%

Upper Layer Canopy Height: Tree 10.1m - Tree 25m

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| PRVI | Prunus virginiana | Chokecherry | Middle |
| QUMA2 | Quercus macrocarpa | Bur oak | Mid-Upper |

Description

Open canopy stand. Patches of dense doghair and 200yr+ old trees persist. Bur oak mostly restricted to northern Black Hills and Bear Lodge. Common juniper and roughleaf ricegrass common in Black Hills.

Other understory species same as in Class C and Class A.

It is thought that Class D should occupy ~60% of the historical landscape (see figure 3 in Brown and Cook [2006] for some rough numbers, which found that ~60% of the reconstructed historical stands had <~20 m2/ha basal area which would probably be late open).

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

Class E 9 Late Development 1 - Closed

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: 51 - 100%

Upper Layer Canopy Height: Tree 10.1m - Tree 25m

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| JUCO6 | Juniperus communis | common juniper | Low-Mid |

Description

Closed canopy, multi-layer stand.

Bur oak occurs in the northern Black Hills and Bear Lodge Mountains.

Understory species the same but fewer numbers. Common or Rocky Mountain juniper might be present with lack of disturbance. Outside of the Black Hills sun sedge and littleseed ricegrass may be present.

See figure 5 in Brown (2006); closed canopy conditions were probably transient due to regional synchronous recruitment forced by climate (i.e., the distinction between fire history and fire regime).

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

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:OPN | 15 |
| Mid1:OPN | 16 | Late1:OPN | 49 |
| Mid1:CLS | 16 | Late1:CLS | 49 |
| Late1:OPN | 50 | Late1:OPN | 999 |
| Late1:CLS | 50 | 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 | 14 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Surface Fire | Early1:ALL | Early1:ALL | 0.05 | 20 | No | 0 |
| Alternative Succession | Mid1:OPN | Mid1:CLS | 1 | 1 | Yes | 25 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.005 | 200 | No | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.05 | 20 | No | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Surface Fire | Mid1:CLS | Mid1:CLS | 0.05 | 20 | No | 0 |
| Alternative Succession | Late1:OPN | Late1:CLS | 1 | 1 | Yes | 60 |
| Mixed Fire | Late1:OPN | Mid1:OPN | 0.0025 | 400 | Yes | 0 |
| Mixed Fire | Late1:OPN | Late1:OPN | 0.0025 | 400 | No | 0 |
| Insects or Disease | Late1:OPN | Early1:ALL | 0.003 | 333 | Yes | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Insects or Disease | Late1:OPN | Mid1:OPN | 0.004 | 250 | Yes | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.05 | 20 | No | 0 |
| Insects or Disease | Late1:OPN | Late1:OPN | 0.05 | 20 | No | 0 |
| Mixed Fire | Late1:CLS | Mid1:CLS | 0.0006 | 1667 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late1:CLS | 0.0006 | 1667 | No | 0 |
| Mixed Fire | Late1:CLS | Mid1:OPN | 0.0019 | 526 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late1:OPN | 0.0019 | 526 | Yes | 0 |
| Insects or Disease | Late1:CLS | Early1:ALL | 0.003 | 333 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Insects or Disease | Late1:CLS | Late1:OPN | 0.01 | 100 | Yes | 0 |
| Insects or Disease | Late1:CLS | Late1:CLS | 0.025 | 40 | No | 0 |
| Surface Fire | Late1:CLS | Late1:OPN | 0.05 | 20 | Yes | 0 |

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