11790

Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna

BpS Model/Description Version: Aug. 2020

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| --- | --- | --- | --- |
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**Reviewed by:** Shannon Murphy

Vegetation Type

Forest and Woodland

Map Zone

31

Geographic Range

This system occurs in map zone (MZ) 31 in ECOMAP subsections 332Ca-d, 331Fn-j-b, 331Ft, 331Fh, 331Fk, 331Fr, and maybe 331Fe. Within MZ31, major examples of this Biophysical Setting (BpS) are restricted to the Pine Ridge in extreme northwestern Nebraska (Dawes, Sheridan, Rock, and Sioux counties) and the canyon of the Niobrara River in its central reaches (Cherry, Brown, and Keya Paha counties). In the Pine Ridge, it is found generally on all aspects of the escarpments at all elevations. Along the Niobrara River, it is confined to upper canyon rims, including areas of sedimentary rimrock on the north rim and eolian sands on the south rim. Elsewhere, smaller occurrences can be found in areas of rocky outcrops and bluffs where grass fires were limited.

Biophysical Site Description

This geology is typically sedimentary in origin. It is often found on buttes, hogbacks, rocky outcrops, and steep, rocky slopes. Elevations range from 4,400ft in the Pine Ridge and down to 2,000ft at the eastern limit of distribution along the Niobrara River. It is likely a combination of a lack of suitable fire-protected sites as the canyon rim becomes less rugged eastward and increasing moisture, leading to increased disease incidence, that controls the eastern distribution limit.

The Middle Niobrara River trees are peculiar in even being present and result from a peculiar accident of geology (John Ortmann, TNC, personal communication).

Vegetation Description

This type is dominated by Rocky Mountain ponderosa pine, which is often the only tree present. Understory composition varies. Rocky Mountain juniper is present in the Pine Ridge, and a native juniper, possibly an intergrade between Rocky Mountain juniper and Eastern red cedar (Haverbeek), is present along the Niobrara River. Common juniper can occur on ridge and rim tops in both areas. Bur oak might also occur.

Herbaceous species include needlegrasses, gramma grasses, little bluestem, western wheatgrass, sedges, and *Astragalas* species. Along the Niobrara, herbaceous species include many from surrounding prairies, the northern mixedgrass prairie on the north side of the river and Sandhill prairie on the south side. On sandy soils derived from weather sandstones, Sandhill species such as sand bluestem, prairie sandreed, and sand dropseed can be common on lower canyon slopes.

In both Nebraska areas, hardwood-dominated draws are common in the bottoms of side canyons. These are dominated by green ash in the Pine Ridge and bur oak along the Niobrara River. Most diversity is present on the central Niobrara River, including bur oak, hackberry, linden, ironwood, green ash, and American elm and, on the south rim, black walnut and paper birch. There is a limited area around Smith Falls State Park east of Valentine that supports several clones of what are believed to be hybrid aspens (quaking X bigtooth) that have persisted from the Pleistocene.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIPO | *Pinus ponderosa* | Ponderosa pine |
| JUSC2 | *Juniperus scopulorum* | Rocky mountain juniper |
| RHTR | *Rhus trilobata* | skunkbush sumac |
| PASM | *Pascopyrum smithii* | Western wheatgrass |
| CAREX | *Carex* | Sedge |
| QUMA2 | *Quercus macrocarpa* | Bur oak |

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

Disturbance Description

This system has generally frequent fires of low severity (Fire Regime Group I). Mixed-severity fire can occur in the closed-canopy conditions (however, only modeled in Class A), a very rare stand density occurs in limited topographically protected sites, and stand-replacement fire is very infrequent (300yrs+). In the nearby and similar BpS 11792, low-severity fires are frequent and range from <10yrs to >20yrs (Brown and Sieg 1999; Fisher et al. 1987) but probably not >40yrs at the high end (3-70yrs range). The mean fire return interval (MFRI) is ~12-15yrs for low-severity fires. Along the Niobrara Valley rim, MFRIs of ~5yrs have been documented for the period 1850-1900, resulting from prairie fires sweeping down the upper bluff forests (Bragg 1994). See Murphy (2017) for a synthesis of fire regimes in the ponderosa pine communities of the Black Hills and surrounding areas.

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). However, Brown (2006) argues that surface fire was the dominant mode of fire disturbance and that the role of mixed-severity fires is overstated.

The surgeon’s log at Fort Robinson in 1893 states that the White River face has steep acclivities that are black with the pines that have given their name to the ridge. The forest growth is limited by the creek, and beyond are grass-grown prairies whose annual fires have destroyed the pine seedlings. A drive of 12mi would take us to the summit and bring to view a rolling fertile land that sinks by gentle slopes to the level of the Niobrara on Running Waters. Things would have changed some by 1893, but this area didn’t settle heavily until at least two decades after that. Additionally, a form he had to fill out stated that the trees were mostly up on the ridges. So, this documents a very high-frequency fire regime, at least at that time. (The last armed conflict with Native Americans was in 1890, so Native American influences on the fire regime were already tremendously affected – probably shorter. Higgins suggested that with the coming of the railroads, fire frequencies increased significantly [Mary Lata, USFS, personal communication]).

Variation in precipitation and temperature interacting with fire, tip moths, and ungulate grazing affects pine regeneration. Windthrow, storm damage, and mountain pine beetles were minor disturbances in this type unless stands reach high densities. The interactions among drought, insects, and disease are not well understood. They are also not modeled for MZ31.

*Ips* spp. of bark beetles can cause mortality among pole-sized and larger-diameter pines, especially those weakened by drought, fire injury, and the hail-related native disease *diplodia*. This has not been a significant factor in the lower-elevation disjunct occurrences in MZ31, however. It is thought that some environmental restraint keeps them out.

Bragg (1991) calculated an MFRI of 4.8yrs from 1850-1900, increasing to 7.0yrs between 1900 and 1950 in ponderosa pine areas of the Nebraska Sandhills.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 419 | 3 |  |  |
| Moderate (Mixed) | 101 | 14 |  |  |
| Low (Surface) | 17 | 83 | 3 | 70 |
| All Fires | 14 | 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 to 10,000s of acres. On the Pine Ridge in Nebraska, fires could have at least been 75-100,000ac, as evidenced by current fires that have burned there (~60,000ac) and that would have continued to burn if they weren't suppressed.

Because occurrence along the Niobrara is highly linear and narrow north to south, many fires in this type would have been part of larger prairie fires.

Adjacency or Identification Concerns

This type is either surrounded by Northern Plains grasslands and shrublands or is a transition between Northern Plains grasslands and shrublands and higher-elevation coniferous forests. Ponderosa pine in this BpS has encroached into the Northern Plains grassland and shrubland types in many areas due to fire exclusion and grazing.

K. Kindscher (personal communication, 2007) believes that almost all of the ponderosa pine stands in Nebraska were there at the time of settlement and are not a result of pine expansion due to fire exclusion; in addition, at least some have disappeared, such as the one in southern Nebraska (Franklin County). It is possible, however, that some areas of this system have expanded in size due to fire exclusion, but this needs substantiation (NatureServe 2013).

Invasive species in this system include cheatgrass, Japanese brome, crested wheatgrass, Kentucky bluegrass, smooth brome, and intermediate wheatgrass. Crested wheatgrass and cheatgrass are at lower elevations mostly. Cheatgrass has altered the fire frequency and extent (although not on the Pine Ridge).

Currently, there have probably been at least 5 to 10 fire cycles that have been missed due to exclusion, grazing, etc. Therefore, the system today would look much more like the late closed stage with ~50-80% canopy closure -- uncharacteristic. Also, encroachment into prairies by pine and juniper is an issue today, although JUSC2 is an indicator at least in the Black Hills. Generally, the encroachment that is an issue with the prairies east of the Black Hills is the Eastern red cedar. As it continues to be incorporated into windbreaks, it continues to invade into new areas. Eastern red cedar is a major invader in pine stands along the central Niobrara River, providing a ladder fuel and increasing complexity and potential intensity of the fuel complex and resulting wildfires in young, even-aged closed stands that have developed post-settlement.

Hardwoods exist in drainages, which encompass a separate BpS. In Nebraska, there is green ash, chokecherry, hackberry, American elm, and bur oak (in Niobrara), which get crowded out by the ponderosa pine.

There is current expansion into grasslands because of fire exclusion, grazing, and natural expansion from Holocene rebound (Norris 2006).

The system in MZ31 is very departed from historical conditions. Stands are grossly overstocked, even-aged (100yrs and less), and occur on landscape positions not formerly occupied (lower, more level slopes). Movement into surrounding prairie also is recent (~100yrs) and continues. Today, there is more in the closed stage and less in the open stage.

The stands in Nebraska are a bit different with different topographic positions than some of the main PIPO range.

Issues or Problems

Much information on nature of pre-settlement stands in MZ31 is in the form of early photographs and non-scientific written accounts.

Native Uncharacteristic Conditions

Some commercial logging has occurred in the Pine Ridge resulting in lower-density, more evenly spaced stands. Logging along the Niobrara is much more limited and usually consists of harvesting single very large trees to local milling. Along the Niobrara, young, even-age stands have developed on lower canyon slopes during the past 100yrs.

Some areas have been thinned to "even spacing," rather than the "clumpier" arrangement that is shown in early photos.

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 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | >3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 0-5 | A | A | A | A | A | C | C | C | C | C |
| Tree | 5-10 | B | B | B | B | B | C | C | C | C | C |
| Tree | 10-25 | B | B | B | B | B | C | C | C | C | C |
| Tree | 25-50 | B | B | B | B | B | C | C | C | C | C |
| Tree | >50 | B | B | B | B | B | C | C | C | C | C |

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 10 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Mid-Upper |
| CALO | Calamovilfa longifolia | Prairie sandreed | Mid-Upper |
| PASM | Pascopyrum smithii | Western wheatgrass | Mid-Upper |

Description

This community is dominated by herbaceous and woody species, including the graminoids: needlegrasses, western wheatgrass, sedges, Idaho fescue, and little bluestem in moister areas and various shrubs, including skunkbush sumac and snowberry. Ponderosa pine seedlings are scattered and found in small clumps. CALO would be common on sandy soils derived from sandstone on the Niobrara rim, PASM on grasslands of the Pine Ridge.

Upper-layer lifeform is not dominant. Dominant lifeform remains herbaceous.

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

Class B 79 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| CALO | Calamovilfa longifolia | Prairie sandreed | Lower |
| PASM | Pascopyrum smithii | Western wheatgrass | Lower |

Description

This class consists of a mature, relatively stable, uneven-aged stand with low density. In the Pine Ridge, it is distributed generally over upper and lower slopes. Along the Niobrara River, it is confined to relatively fire-protected areas of upper canyon rims.

This could also include some single-story stands with a few pockets of regeneration. Low shrubs and forbs are also present. Grass still has high cover.

This class persists with disturbance; fire prevents this stage from succeeding to a more densely forested stage.

*Maximum Tree Size Class*  
Very Large >33" DBH

Class C 11 Late Development 1 - Closed

Indicator Species

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

Description

Class C contains odd pockets of ponderosa pine where there are higher density trees and the possibility of stand-replacing disturbances in extreme combinations of conditions.

These are higher-density stands located in either of two landscape positions: 1) small, highly protected topographical positions, i.e., steep secondary canyons with north aspects in both the Pine Ridge and along the Niobrara, there predominantly on the north side (these would be subject to replacement fire when combinations of drought, disease, and insects set up conditions for unusually intense fire for the microsite); and 2) temporary, young, even-age stands that develop on gentler slopes and other areas that would normally support grasses and excessive fire that prevents establishment of pines. This would occur only when a combination of conditions suppressed fire long enough to establish trees to fire-resistant size. Stand would persist and age until destroyed in canopy fire.

Some cool-season grasses could still be present such as *Poa* spp., Canada wildrye, and *carex* spp., but understory is sparser in this class than A and B.

This class may be best distinguished from Class B by DBH as well as cover.

In current conditions, more would be in this class.

*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 | 29 |
| Mid1:OPN | 30 | Mid1:OPN | 999 |
| Late1:CLS | 30 | 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 | Late1:CLS | 1 | 1 | Yes | 28 |
| Mixed Fire | Early1:ALL | Early1:ALL | 0.1 | 10 | No | 0 |
| Optional 1 | Mid1:OPN | Early1:ALL | 0.0013 | 769 | Yes | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Alternative Succession | Mid1:OPN | Late1:CLS | 0.01 | 100 | Yes | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.0667 | 15 | No | 0 |
| Insects or Disease | Late1:CLS | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.007 | 143 | Yes | 0 |
| Surface Fire | Late1:CLS | Mid1:OPN | 0.0667 | 15 | Yes | 0 |

Optional Disturbances

Optional 1: hail

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