11260

Inter-Mountain Basins Montane Sagebrush Steppe

BpS Model/Description Version: Aug. 2020

|  |  |  |  |
| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
| Dave Tart | dtart@fs.fed.us | Kim Reid | kreid@fs.fed.us |
| Stan Kitchen | skitchen@fs.fed.us | Steve Cooper | scooper@mt.gov |
| None | None | Jeff DiBenedetto | jdibenedetto@fs.fed.us |

Vegetation Type

Steppe/Savanna

Map Zones

20, 29, 33

Geographic Range

Scattered throughout the montane zones of the Bighorns in northcentral Wyoming and Pryor Mountains (342Ad, Cleland et al. 2007) in southcentral Montana. In map zone (MZ) 20, this type is thought to be very limited possibly occurring at the extreme southern end of the zone.

Biophysical Site Description

This type can occur from 4,500-8,800ft in the Pryor Mountains in southcentral Montana and from 4,500-9,800ft in the Bighorn Mountains. It is scattered in forest openings throughout the zone and adjacent to lower forested areas. This vegetation type is found on all aspects. Pure stands are found in areas with deeper soils and less topographic relief, but it is also common on slopes with a gradual shift to a mixed mountain shrub community on steeper slopes and in drainages. Soils are deep, well drained.

Vegetation Description

Mountain sagebrush steppe dominated by mountain big sagebrush, with a frequent presence of mountain snowberry, and with a continuous grass and forb understory is believed to be a pre-settlement vegetation type within this MZ, although the exact composition of the community before settlement is unknown.

Dominant shrubs include mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and mountain snowberry (*Symphoricarpos* spp.). Other common shrubs include serviceberry (*Amelanchier alnifolia*), wild cherry (*Prunus virginiana*), rose, and currant. Other shrubs may be locally common.

Herbaceous cover is moderate to abundant, ranging from 40-85%. Common grasses include: *Festuca idahoensis*, *Pseudoroegneria spicata*, *Elymus elymoides*, *Elymus trachycaulus*, *Elymus caninus*, *Stipa occidentalis*, *Hesperostipa comata*, *Koeleria cristata*, and *Poa secunda*. Common forbs include *Geum triflorum*, *Eriogonum umbellatum*, *Antennaria microphyla*, *Balsamorhiza incana*, *Balsamorhiza sagittata*, *Lupinus* spp., *Delphinium* spp., *Castilleja* spp., and *Astragalus* spp. *Geranium viscosissimum* is an indicator of a more mesic phase of this type.

*Purshia tridentata* is typically not present in this type in MZ29.

This vegetation type may occur as inclusions within forested types.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| ARTRV | *Artemisia tridentata ssp. vaseyana* | Mountain big sagebrush |
| PSSP6 | *Pseudoroegneria spicata* | Bluebunch wheatgrass |
| FEID | *Festuca idahoensis* | Idaho fescue |
| POSE | *Poa secunda* | Sandberg bluegrass |
| SYOR2 | *Symphoricarpos oreophilus* | Mountain snowberry |
| BAIN | *Balsamorhiza incana* | Hoary balsamroot |
| BASA3 | *Balsamorhiza sagittata* | Arrowleaf balsamroot |
| GEVI2 | *Geranium viscosissimum* | Sticky purple geranium |

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

Disturbance Description

Fire is a major disturbance factor for mountain big sagebrush (Blaisdell et al. 1982; Johnson 2000). The fire return intervals (FRIs) reported in the literature for this type vary from 10-70yrs (Hironaka et al. 1983; Miller and Rose 1999; Wright and Bailey 1982; Houston 1973; Arno and Gruell 1983) and up to 200yrs (Baker 2006).

Fire regimes vary considerably across the biogeographic range of mountain big sagebrush, based on factors like elevation, soil depth, slope, aspect, adjacent vegetation, frequency of lightning, and climate. Estimating historic fire regimes for sagebrush ecosystems is difficult and often based on fire scar and age structure data from adjacent forest types (e.g., ponderosa pine and pinyon/juniper), shrub age structure, and fuel characteristics.

During the development of the LANDFIRE National models, there was considerable debate about the fire frequency and severity of this Biophysical Setting (BpS) (see MZ21 Disturbance Description for further discussion).

In MZ29, these systems are predominantly adjacent to Douglas-fir fire regimes in the Pryor Mountains and predominantly adjacent to lodgepole pine fire regimes in the Bighorns. Also, both areas are at higher elevations, with the mesic phases (sticky geranium) being prevalent. Some south-slope xeric phases of this type also occur. Baker (2006) describes mountain sagebrush having a fire recovery within ~35-100yrs after fire. He also mentions that xeric sites in eastern Oregon (Waichler et. al. 2001) could be much longer than 75-100yrs. Baker (2006) also states that fires are stand-replacing. Thinning fires do not occur, but rather, a mosaic of burned and unburned areas can occur.

The 10-70yr FRI (Hironaka et al. 1983; Miller and Rose 1999; Wright and Bailey 1982; Houston 1973; Arno and Gruell 1983) is being applied to MZ29 rather than the upper level of 200yrs (anonymous contributor) since the upper range related to xeric aspects to this type and in MZ29 mesic types are prevalent. Some xeric aspects also occur.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 51 | 100 | 10 | 70 |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 51 | 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

Fires burn in patchy mosaics in this type, and scales ranged from small (10s of acres) to moderate (possibly of 1,000s of acres).

On the widely distributed loamy soils, prior to 1900, sagebrush might have been restricted to small patches or widely spaced plants (Arno and Gruell 1983).

Adjacency or Identification Concerns

Differentiation of mountain big sagebrush steppe from Wyoming big sagebrush may be difficult at the ecotone due to physical similarities and hybridization zones (i.e., species concepts become blurred).

Adjacent plant associations on shallow clay soils are dominated by Wyoming big sagebrush.

In MZ29, there is most commonly Douglas-fir and sometimes lodgepole pine encroachment. Douglas-fir and limber pine trees have encroached into sagebrush-grasslands from historically stable tree islands, and tree density has increased on the tree islands (Heyerdahl et al. 2006). Mountain big sagebrush cover decreases rapidly as juniper dominance increases today (Miller et al. 2000 in Heyerdahl et al. 2006).

Nearly all sagebrush communities today have been grazed, and there are no refugia to use as reference conditions.

Some grassland systems are invaded by sagebrush today in larger quantities -- in grassland areas that are adjacent to sagebrush. There might have been an expansion into the grassland systems. These grassland systems might today have mountain big sagebrush, and pre-European settlement, they might have had a bit of mountain sage. Pre-European settlement, they would have been grassland systems, whereas today they might be confused for mountain big sagebrush systems. It might therefore be difficult to distinguish the early seral stages of this class from the Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland BpS (1139). It should be distinguished by elevational component.

There is also a difference in FRI in grassland versus sagebrush systems -- frequent enough fire, and it would be maintained as grassland.

Mountain big sagebrush was probably not as abundant in pre-settlement conditions (Arno and Gruell 1983), since the original vegetation of sagebrush-grass consisted of a dense cover of perennial grasses among which were scattered moderate-sized shrubs.

Fire exclusion is a major effect of livestock grazing (removal of fuel) in dynamic sagebrush/ grassland systems (Miller and Fowler 1994; Miller and Rose 1999; Gruell 1999; Miller et al. 2000; Miller and Eddleman 2000; Crawford et al. 2004).

Issues or Problems

There is a limited amount of information available on fire regimes and reference conditions in sagebrush due to modern overgrazing (the herbaceous component is severely impacted and current information cannot exclude the effects of cattle). Nearly all sagebrush communities today have been grazed -- there are few known refugia to use as reference conditions.

In MZ29, non-native species such as *Phleum pratense*, *Cynoglossum officinale*, and others may occur.

Sagebrush may have invaded some grasslands due to fire exclusion, overgrazing by livestock, and/or climate change.

There was a big shift in the late 1800s with fire intervals, whereas the fire intervals could have been longer in the early 1800s, more akin to present day, due to climate (Tausch, personal correspondence per MZ22 type).

Native Uncharacteristic Conditions

Shrub cover >45% cover or taller than 1m are uncharacteristic; >10% canopy cover by conifers can be considered uncharacteristic. Potential causes of encroachment include grazing and lack of fire, as well as climatic episodes favorable to tree regeneration.

Comments

During LANDFIRE National, a model was not created for MZ33, so it was lumped into the model representing MZs 06, 12, 17, and 28. During the BpS Review in 2017, reviewer Alan Sands suggested that MZ33 did not fit with the MZ06 et al. model, which is centered on the Central Basin and Range ecoregion (US EPA 2013), because of its location on the plains where it is subject to different moisture patterns (e.g., more growing season precipitation). As a result of this review, Kori Blankenship lumped MZ33 with MZ29, which is primarily within a prairie ecoregion (US EPA 2013, Level 2, West-Central, Semi-Arid Prairie). Blankenship also lumped MZ20 into this group (it was previously lumped with MZ21) because it too is mostly in the same prairie ecoregion (West-Central, Semi-Arid Prairie) as MZ29.

During the BpS Review in 2017, this model was part of a “macro-review” where all models representing this BpS were reviewed and evaluated relative to one another. One goal of the review was to check for logical consistency between the models. Outstanding questions from this review that should be evaluated in the future include:

-Should all models for this BpS include a tree succession class? The current model set includes models that have tree succession classes and those that do not. The models representing MZ06 et al. and MZ13 note that the Ecological Systems classification does not distinguish between mid- to high-elevation mountain big sagebrush communities that can be invaded by conifers and those at elevations too high for tree encroachment. The MZ06 et al. description also notes that where tree encroachment is impossible, a three-box model (i.e., this model without tree classes D and E) should be used. Sands, during the 2017 BpS Review, suggested that all models for this BpS include a tree succession class.

-Does the low sagebrush versus mountain big sagebrush split applied in the model representing MZs 16, 23, and 24 apply elsewhere? This split was implemented by modelers to allow low sagebrush communities to have a much lower fire frequency than mountain big sagebrush communities. MZ06 et al. notes that mountain low sagebrush communities should be classified as Columbia Plateau Low Sagebrush Steppe **(**BpS 1124). MZ13 notes that extensive areas of low/black sagebrush should be considered Great Basin Xeric Mixed Sagebrush Shrubland (BpS 1079).

-What is an appropriate fire frequency and severity for this BpS? Estimates for these fire regime parameters vary widely (see Innes 2017), and during LANDFIRE National, there was considerable debate about these values in some areas (see LANDIFRE MZ21 description for this BpS).

For MZ29, this model was based on the model from MZ21 remodeled by Dave Tart and Stan Kitchen and reviewed by Steve Kilpatrick and Klara Varga. MZ29 changes included descriptive additions/changes for Bighorns and Pryors. Another LANDFIRE National reviewer for MZ29 was Jim Von Loh.

This model for MZ21 is based on the LANDFIRE model for the same BpS 1126 for MZs 10 and 19, created by Kathy Geier-Hayes (kgeierhayes@fs.fed.us), Steve Rust (srust@idfg.idaho.gov), and Susan Miller (smiller03@fs.fed.us) and reviewed by Dana Perkins (dana\_perkins@blm.gov), Carly Gibson (cgibson@fs.fed.us), and Mary Manning (mmanning@fs.fed.us). Original modelers for MZ21 were Tim Klukas (tim\_klukas@nps.gov), Reggie Clark (rmclark@fs.fed.us), John Simons (john\_simons@blm.gov), and an anonymous contributor. Original reviewers for MZ21 were Steve Kilpatrick, Klara Varga, Stan Kitchen (skitchen@fs.fed.us), Dave Tart, and Brenda Fiddick. Because there were significant differences of opinion between the original modelers and the reviewers, no compromise could be reached. After an extensive model review process, LANDFIRE leadership/guidance determined that the original modelers used an interpretation of the fire information available on sagebrush systems that did not represent the majority expert opinion/interpretation of the fire literature. Therefore, the original MZ21 model was altered to reflect majority opinion/interpretation of literature regarding the fire regime of this sagebrush system.

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 | UN | UN | UN | UN |
| Herb | 0.5-1.0 | A | A | A | A | A | A | UN | UN | UN | UN |
| Herb | >1.0 | A | A | A | A | A | A | UN | UN | UN | UN |
| Shrub | 0-0.5 | B | B | B | C | C | UN | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | B | B | B | C | C | 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 | C | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 10-25 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 25-50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | >50 | UN | UN | UN | UN | UN | 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 23 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| FEID | Festuca idahoensis | Idaho fescue | Lower |
| PSSP6 | Pseudoroegneria spicata | Bluebunch wheatgrass | Lower |
| FORBS | <NOT FOUND IN NRCS> | <NOT FOUND IN NRCS> | Lower |

Description

Shrub cover is low and typically ranges from 0-10%; 5% shrub cover indicates good establishment of a post-fire cohort. Herbaceous cover is variable but is typically at least 30%.

In this environment (and a number of the other grassland, shrub steppe types), forb density and cover are most responsive to climatic conditions. Hence, fire response will vary according to precipitation patterns before and immediately after the fire. Grasses are less “ephemeral” and tend to respond to the fire directly. That’s why some reviewers elected not to identify specific forb species response.

A LANDFIRE National reviewer for MZ29 felt there should be more of this class historically than 25%, based on 50yr FRIs. However, the reviewer did not want to alter model based on review. Currently, there is probably less of Class A on the landscape.

*Maximum Tree Size Class*  
None

Class B 51 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ARTRV | Artemisia tridentata ssp. vaseyana | Mountain big sagebrush | Upper |
| FEID | Festuca idahoensis | Idaho fescue | Lower |
| PSSP6 | Pseudoroegneria spicata | Bluebunch wheatgrass | Lower |

Description

Shrubs are the upper layer. Reaching 20% sagebrush cover following a stand-replacing fire takes between 10-33yrs (Tart, personal correspondence). Welch (2005 per Tisdale et al. 1965) and Winward (1991) describe pre-settlement canopy cover being 10-20%, composed mostly as open stands. There is a 40% herbaceous canopy cover across this class. Native grazing on winter ranges by elk and deer typically may decrease sagebrush cover.

*Maximum Tree Size Class*  
None

Class C 26 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ARTRV | Artemisia tridentata ssp. Vaseyana | Mountain big sagebrush | Upper |
| PSSP6 | Pseudoroegneria spicata | Bluebunch wheatgrass | Lower |
| FEID | Festuca idahoensis | Idaho fescue | Lower |

Description

Sagebrush is dominant. Sagebrush cover rarely exceeds 40% cover. Mountain big sagebrush canopy cover is constrained by competition from herbaceous vegetation on all but the wettest sites (Tart 1996). Competition between herbs and sagebrush is less pronounced on cooler, wetter sites. High canopy cover of mountain big sagebrush only develops after removal of herbaceous vegetation. Some researchers believe that mountain big sagebrush can never exceed 25% cover (Pedersen et al. 2003). Understory vegetation has low cover in this class. Insects, killing freeze, and drought stress thin sagebrush cover.

A LANDFIRE National reviewer stated that there would be less of this class on the landscape historically, based on the 50yr FRI. However, the reviewer did not want to alter the model. Currently, however, there is probably more of Class C on the landscape due to lack of fire.

*Maximum Tree Size Class*  
None

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:OPN | 13 |
| Mid1:OPN | 14 | Late1:CLS | 45 |
| Late1:CLS | 46 | 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** |
| Native Grazing | Early1:ALL | Early1:ALL | 0.002 | 500 | No | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Native Grazing | Mid1:OPN | Mid1:OPN | 0.002 | 500 | No | 0 |
| Insects or Disease | Mid1:OPN | Mid1:OPN | 0.005 | 200 | No | 0 |
| Wind or Weather or Stress | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Native Grazing | Late1:CLS | Late1:CLS | 0.002 | 500 | No | 0 |
| Wind or Weather or Stress | Late1:CLS | Mid1:OPN | 0.01 | 100 | Yes | 0 |
| Insects or Disease | Late1:CLS | Mid1:OPN | 0.013 | 77 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.02 | 50 | Yes | 0 |

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