11260

Inter-Mountain Basins Montane Sagebrush Steppe

BpS Model/Description Version: Aug. 2020

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

Reviewer: Alan Sands

Vegetation Type

Steppe/Savanna

Map Zone

13

Geographic Range

Montane and subalpine elevations across the western United States from 1,000m in eastern Oregon and Washington to >3,000m in the southern Rockies and within the mountains of Nevada, including southern Nevada, western Utah, southeastern Wyoming, and southern Idaho. In map zone (MZ) 13, restricted to the highest mountains such as the Panamint Range, Inyo Range, and Spring Mountains.

Biophysical Site Description

This ecological system occurs in much of the western United States, usually at middle elevations (1,000-2,500m). Within the Mojave Desert mapping zone (MZ13), elevation is generally >2,450m, with known occurrences >2,790m in the Panamint Range. Immediately north of the Mojave Desert, mountain big sagebrush shrublands occur up to 3,200m in the White Mountains of California (Winward and Tisdale 1977; Blaisdell et al. 1982; Cronquist et al. 1994; Miller and Eddleman 2000). The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 25-90cm/yr (Mueggler and Stewart 1980; Tart 1996). Much of this precipitation falls as snow. Temperatures are continental with large annual and diurnal variation. In general, this system shows an affinity for mild topography, fine soils, and some source of subsurface moisture. Soils generally are moderately deep to deep, well drained, and of loam, sandy loam, clay loam, or gravelly loam textural classes; soils often have a substantial volume of coarse fragments and are derived from a variety of parent materials. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. Soils are typically deep and have well-developed dark organic surface horizons (Hironaka et al. 1983; Tart 1996). However, at the high ends of its precipitation and elevation ranges, mountain big sagebrush occurs on shallow and/or rocky soils. All aspects are represented, but the higher-elevation occurrences may be restricted to south- or west-facing slopes. At lower elevations, mountain big sagebrush occurs in the understory of curlleaf mountain mahogany and pinyon-juniper woodlands.

Vegetation Description

Vegetation types within this ecological system are usually <1.5m tall and dominated by *Artemisia tridentata* ssp. *vaseyana*. Mojave Desert communities of montane sagebrush have received less description than northern MZs. A variety of other shrubs can be found in some occurrences, but these are seldom dominant. They include *Artemisia arbuscula*, *Ericameria nauseosa*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Symphoricarpos oreophilus*, *Purshia tridentata*, *Peraphyllum ramosissimum*, *Ribes cereum*, and *Amelanchier alnifolia*. The canopy cover is usually between 20-80%. The herbaceous layer is usually well represented, but bare ground may be common in particularly arid or disturbed occurrences. Graminoids that can be abundant include *Boutela gracilis*, *Festuca ovina*, *Elymus elymoides*, *Danthonia intermedia*, *Stipa* spp., *Pascopyrum smithii*, *Bromus carinatus*, *Elymus trachycaulus*, *Koeleria macrantha*, *Pseudoroegneria spicata*, *Bromus anomalous*, *B. marginatus*, *Achnatherum therburianum*, *Poa fendleriana*, or *Poa secunda*. Forbs are often numerous and are an important indicator of health. Forb species may include *Castilleja*, *Potentilla*, *Erigeron*, *Phlox*, *Astragalus*, *Geum*, *Lupinus*, *Eriogonum*, *Achillea millefolium*, *Antennaria rosea*, *Eriogonum umbellatum*, *Artemisia ludoviciana,* and many others. Mueggler and Stewart (1980), Hironaka et al. (1983), and Tart (1996) described several of these types. Resprouting bitterbrush in mountain big sagebrush types is potentially important to wildlife in early stand development.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| ARTRV | *Artemisia tridentata ssp. vaseyana* | Mountain big sagebrush |
| PUTR2 | *Purshia tridentata* | Antelope bitterbrush |
| SYOR2 | *Symphoricarpos oreophilus* | Mountain snowberry |
| POFE | *Poa fendleriana* | Muttongrass |
| BRMA4 | *Bromus marginatus* | Mountain brome |

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

Disturbance Description

Mean fire return intervals (MFRIs) in and recovery times of mountain big sagebrush are subjects of lively debate in recent years (Welch and Criddle 2003). Mountain big sagebrush communities were historically subject to stand-replacing fires with a MFRI ranging from 40yrs+ at the big sagebrush ecotone and up to 80yrs in areas with a higher proportion of low sagebrush in the landscape (Crawford et al. 2004; Johnson 2000; Miller and Rose 1999; Burkhardt and Tisdale 1969 and 1976; Houston 1973; Miller and Rose 1995; Miller et al. 2000). Under pre-settlement conditions, mosaic burns generally exceeded 75% topkill due to the relatively continuous herbaceous layer. Brown (1982) reported that fire ignition and spread in big sagebrush is largely (90%) a function of herbaceous cover. These communities were also subject to periodic mortality due to insects, disease, rodent outbreaks, drought, and winterkill (Anderson and Inouye 2001; Winward 2004). Periodic mortality events may result in either stand-replacement or patchy die-off, depending on the spatial extent and distribution of these generally rare (50-100yrs) events.

Recovery rates for shrub canopy cover vary widely in this type, depending on post-fire weather conditions, sagebrush seed-bank survival, abundance of resprouting shrubs (e.g., snowberry, bitterbrush), and size and severity of the burn. Mountain big sagebrush typically reaches 5% canopy cover in 8-14yrs. This may take as little as 4yrs under favorable conditions and >25yrs in unfavorable situations (Pedersen et al. 2003; Miller unpublished data). Mountain big sagebrush typically reaches 25% canopy cover in ~25yrs, but this may take as few as 9yrs or >40yrs (Winward 1991; Pedersen et al. 2003; Miller unpublished data). Mountain snowberry and resprouting forms of bitterbrush may return to pre-burn cover values in a few years. Bitterbrush plants <50yrs old are more likely to resprout than older plants (Simon 1990).

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 50 | 100 | 15 | 100 |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 50 | 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 occupies areas ranging in size from 10s to 5,000s of acres, although patch sizes are generally smaller in the Mojave Desert. Disturbance patch size can range from 10s to 1,000s of acres. The distribution of past burns was assumed to consist of many small patches in the landscape.

Adjacency or Identification Concerns

Inter-Mountain Basins Montane Sagebrush Steppe that are dominated by mountain big sagebrush Biophysical Setting (BpS) 1126 will contain low/black sagebrush in varying amounts. Small patches will naturally be part of BpS 1126, whereas more extensive areas truly belong to the Great Basin Xeric Mixed Sagebrush Shrubland BpS (1079). Both systems (BpS 1126 and 1079) cover large high-elevation areas in the Intermountain West. Mountain big sagebrush is a medium-sized shrub with an MFRI from 10-70yrs, whereas high-elevation low sagebrush is a dwarf shrub with an MFRI of 200yrs+.

The NatureServe description does not distinguish between mountain big sagebrush that can be invaded by conifers at mid to high elevations (i.e., within the tolerance of pinyon and juniper) and mountain sagebrush steppe that is too high elevation for pinyon to encroach. The ability for pinyon to invade has a large effect on the predicted historical range of variability and management.

This type may be adjacent to forests dominated by aspen, white fir, limber pine, and bristlecone pine. It also occurs adjacent to pinyon-juniper and curlleaf mountain mahogany woodlands. The ecological system, where adjacent to conifers, is readily invaded by conifers (whitebark pine, limber pine, pinyon-pine, and juniper spp.) in the absence of historic fire regimes (Miller and Rose 1999).

At lower elevational limits on southern exposures, there is a high potential for cheatgrass invasion/occupancy where the native herbaceous layer is depleted. This post-settlement, uncharacteristic condition is not considered here.

Grazing could occur in this system, bringing the herbaceous cover lower.

Issues or Problems

BpS 1126, Inter-Mountain Basins Montane Sagebrush Steppe, was not part of list of keyed BpS for this MZ due to the paucity of data. BpS 1126 is found, however, in the Inyo Range (Inyo National Forest), Panamint Range (Death Valley National Park), and perhaps in the Spring Mountains depending on whether or not pinyon has invaded shrublands.

Native Uncharacteristic Conditions

Shrub cover >50% (remote sensing) is uncharacteristic, and conifer cover >80% (remote sensing) is uncharacteristic where trees occur in the context of Class E. Uncharacteristic conditions in this type include herbaceous canopy cover <40%.

Comments

The first three development classes chosen for this BpS correspond to the early, mid, and late seral stages familiar to range ecologists. The two classes with conifer invasion (classes D and E) approximately correspond to Miller and Tausch's (2001) phases 2 and 3 of pinyon and juniper invasion into shrublands.

Alan Sands reviewed and made descriptive changes to this BpS during the BpS Review in 2017.

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).

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 | A | A | A | A | UN | UN |
| Herb | 0.5-1.0 | UN | UN | UN | UN | A | A | A | A | UN | UN |
| Herb | >1.0 | UN | UN | UN | UN | A | A | A | A | UN | UN |
| Shrub | 0-0.5 | B | B | C | C | C | UN | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | B | B | C | C | C | UN | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | B | B | C | C | C | UN | UN | UN | UN | UN |
| Shrub | >3.0 | B | B | C | C | C | UN | UN | UN | UN | UN |
| Tree | 0-5 | D | D | D | E | E | E | E | E | UN | UN |
| Tree | 5-10 | D | D | D | E | E | E | E | E | 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 22 Early Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| POFE | Poa fendleriana | Muttongrass | Upper |
| BRMA4 | Bromus marginatus | Mountain brome | Upper |
| SYOR2 | Symphoricarpos oreophilus | Mountain snowberry | Lower |
| ARTRV | Artemisia tridentata ssp. vaseyana | Mountain big sagebrush | Lower |

Description

Herbaceous vegetation is the dominant lifeform. Herbaceous cover is variable but typically >50% (50-80%). Scatter shrubs with 0-5% cover up to .5m tall.

*Maximum Tree Size Class*  
None

Class B 48 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ARTRV | Artemisia tridentata ssp. vaseyana | Mountain big sagebrush | Upper |
| PUTR2 | Purshia tridentata | Antelope bitterbrush | Upper |
| PIPO5 | <NOT FOUND IN NRCS> | <NOT FOUND IN NRCS> | Lower |
| SYOR2 | Symphoricarpos oreophilus | Mountain snowberry | Lower |

Description

Shrub cover increases, but herbs are still the dominant lifeform with typically >50% cover. Mountain big sagebrush cover up to 20%. Initiation of conifer seedling establishment.

*Maximum Tree Size Class*  
Seedling <4.5ft

Class C 13 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ARTRV | Artemisia tridentata ssp. vaseyana | Mountain big sagebrush | Upper |
| PUTR2 | Purshia tridentata | Antelope bitterbrush | Upper |
| SYOR2 | Symphoricarpos oreophilus | Mountain snowberry | Low-Mid |
| CONIF | <NOT FOUND IN NRCS> | <NOT FOUND IN NRCS> | Mid-Upper |

Description

Shrubs are the dominant lifeform. Herbaceous cover is typically <50%. Conifer (juniper, pinyon-juniper, ponderosa pine, or white fir) cover <10%.

*Maximum Tree Size Class*  
None

Class D 11 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CONIFER | <NOT FOUND IN NRCS> | <NOT FOUND IN NRCS> | Upper |
| ARTRV | Artemisia tridentata ssp. Vaseyana | Mountain big sagebrush | Mid-Upper |
| PUTR2 | Purshia tridentate | Antelope bitterbrush | Mid-Upper |
| SYMPH | Symphoricarpos | Snowberry | Low-Mid |

Description

Conifers are the upper lifeform (juniper, pinyon-juniper, ponderosa pine, limber pine, or white fir). Shrub cover is generally less than mid-development classes but remains between 26-40%. Herbaceous cover <30%.

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

Class E 6 Late Development 2 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CONIFER | <NOT FOUND IN NRCS> | <NOT FOUND IN NRCS> | Upper |
| ARTRV | Artemisia tridentata ssp. Vaseyana | Mountain big sagebrush | Mid-Upper |
| PUTR2 | Purshia tridentata | Antelope bitterbrush | Mid-Upper |
| SYMPH | Symphoricarpos | Snowberry | Mid-Upper |

Description

Conifers are the dominant lifeform (juniper, pinyon-juniper, ponderosa pine, limber pine, or white fir). Conifer cover ranges from 26-80% (pinyon-juniper 36-80% [Miller and Tausch 2001], juniper 26-40% [Miller and Rose 1999], white fir 26-80%). Shrub cover 0-20%. Herbaceous cover <20%. Conifers are susceptible to insects/diseases that cause diebacks.

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

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:OPN | 0 | Mid1:OPN | 11 |
| Mid1:OPN | 12 | Late1:CLS | 49 |
| Late1:CLS | 50 | Late1:CLS | 999 |
| Late1:OPN | 70 | Late2:CLS | 114 |
| Late2:CLS | 115 | Late2: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:OPN | Early1:OPN | 0.0125 | 80 | Yes | 0 |
| Replacement Fire | Mid1:OPN | Early1:OPN | 0.025 | 40 | Yes | 0 |
| Insects or Disease | Late1:OPN | Late1:OPN | 0.013 | 77 | No | 0 |
| Replacement Fire | Late1:OPN | Early1:OPN | 0.02 | 50 | Yes | 0 |
| Alternative Succession | Late1:CLS | Late1:OPN | 1 | 1 | Yes | 80 |
| Insects or Disease | Late1:CLS | Mid1:OPN | 0.013 | 77 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:OPN | 0.02 | 50 | Yes | 0 |
| Insects or Disease | Late2:CLS | Late1:OPN | 0.013 | 77 | Yes | 0 |
| Replacement Fire | Late2:CLS | Early1:OPN | 0.013 | 77 | Yes | 0 |

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