11261

Inter-Mountain Basins Montane Sagebrush Steppe - Mountain Big Sagebrush

BpS Model/Description Version: Aug. 2020

Reviewer: Alan Sands

Vegetation Type

Steppe/Savanna

Map Zones

16, 23, 24

Model Splits or Lumps

This Biophysical Setting (BpS) is split into multiple models: 11261 is dominated by mountain big sagebrush and is characterized by a moderate-frequency, high-severity fire regime; 11262 is dominated by low sagebrush and is characterized by a low-frequency fire regime.

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, Utah, southeastern Wyoming, and southern Idaho.

Biophysical Site Description

This ecological system occurs in many of the western states, usually at middle elevations (1,000-2,500m). Within the Great Basin region, elevation ranges from 1,370m in Idaho 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). However, elevations are predominantly between 1,525-2,750m.

The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 25-90cm/year (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. Soils are typically deep and have well-developed dark organic surface horizons (Hironaka et al. 1983; Tart 1996). This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. 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.

Vegetation Description

Vegetation types within this ecological system are usually <1.5m tall and dominated by *Artemisia tridentata* ssp. *vaseyana*, *Artemisia cana* ssp. *Viscidula*, or *Artemisia tridentata* ssp. *spiciformis*. A variety of other shrubs can be found in some occurrences, but these are seldom dominant. They include *Artemisia rigida*, *Artemisia arbuscula*, *Ericameria nauseosa*, *Chrysothamnus viscidiflorus*, *Symphoricarpos oreophilus*, *Purshia tridentata*, *Peraphyllum ramosissimum*, *Ribes cereum*, *Rosa woodsii*, *Ceanothus velutinus*, 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 *Festuca idahoensis*, *Festuca thurberi*, *Festuca ovina*, *Elymus elymoides*, *Deschampsia caespitosa*, *Danthonia intermedia*, *Danthonia parryi*, *Stipa* spp., *Pascopyrum smithii*, *Bromus carinatus*, *Elymus trachycaulus*, *Koeleria macrantha*, *Pseudoroegneria spicata*, *Poa fendleriana*, *Poa secunda*, and *Carex* spp. Forbs are often numerous and an important indicator of health. Forb species may include *Castilleja*, *Potentilla*, *Erigeron*, *Phlox*, *Astragalus*, *Geum*, *Lupinus*, *Eriogonum*, *Balsamorhiza sagittata*, *Achillea millefolium*, *Antennaria rosea*, *Eriogonum umbellatum*, *Fragaria virginiana*, *Artemisia ludoviciana*, *Hymenoxys hoopesii* (=*Helenium hoopesii*), etc. Mueggler and Stewart (1980), Hironaka et al. (1983), and Tart (1996) described several of these types. This ecological system is critical summer habitat for greater sage grouse. Moreover, resprouting bitterbrush in mountain big sagebrush types is potentially important to wildlife in early stand development.

BpS Dominant and Indicator Species

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 complex and subject to lively debate in recent years (Welch and Criddle 2003). One reason for this complexity is that mountain big sagebrush is found on many and very different NRCS ecological range sites. Mountain big sagebrush communities were historically subject to stand-replacing fires with a MFRI ranging from 10yrs at the ponderosa pine ecotone, 40yrs+ at the Wyoming 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, 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

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 10,000s of acres. Disturbance patch size can also 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 (BpS 1126) was separated into two very distinct montane sagebrush steppe types not distinguished by NatureServe: Inter-Mountain Basins Montane Sagebrush Steppe dominated by mountain big sagebrush (11261) and Inter-Mountain Basins Montane Sagebrush Steppe dominated by low sagebrush (11262). Both systems cover large high-elevation areas in the Intermountain West. Mountain big sagebrush is a tall shrub with an MFRI from 10-70yrs, whereas high-elevation low sagebrush is a dwarf shrub with an MFRI of 200yrs+. Subalpine and montane dwarf sagebrush types (i.e., Rocky Mountain Alpine Dwarf Shrubland [1070] and Inter-Mountain Basins Montane Sagebrush Steppe -- Low Sagebrush [11262]) tend to occur adjacent to Inter-Mountain Basins Montane Sagebrush Steppe -- Mountain Big Sagebrush (11261). The dwarf sagebrush types create a mosaic within the mountain big sagebrush types, acting as a fire break that burns only under severe conditions. Often, dwarf sagebrush types are the larger community in which mountain big sagebrush are stringers associated with drainages.

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, ponderosa pine, Douglas-fir, limber pine, bristlecone pine, or lodgepole pine. It also occurs adjacent to pinyon-juniper woodlands. The ecological system, where adjacent to conifers, is readily invaded by conifers (ponderosa pine, Douglas-fir, subalpine fir, whitebark pine, limber pine, pinyon-pine, and juniper spp.) in the absence of historic fire regimes (Miller and Rose 1999). This type probably served as an ignition source for adjacent aspen stands. Mountain big sagebrush is commonly found adjacent to or intermingled with low sagebrush and mountain shrublands.

At lower-elevation 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.

Issues or Problems

Reviewers and modelers had very different opinions on the range of MFRIs and mountain big sagebrush recovery times (see Welch and Criddle 2003). It is increasingly agreed upon that an MFRI of 20yrs, which used to be the accepted norm, is simply too frequent to sustain populations of greater sage grouse and mountain big sagebrush ecosystems whose recovery time varies from 10-70yrs. Reviewers consistently suggested longer fire return intervals (FRIs) and recovery times. The revised model is a compromise with longer recovery times and FRIs. Modeler and reviewers also disagreed on the choice of fire regime group: high-frequency, high-severity (modeler) vs. moderate-frequency, high-severity (reviewers).

Native Uncharacteristic Conditions

Uncharacteristic conditions in this type include herbaceous canopy cover <40% and dominance of the herbaceous layer by mulesears (*Wyethia amplexcaulis*) on clayey soils.

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.

This BpS was reviewed and descriptive changes made by Alan Sands during the BpS Review in 2017. Map zones (MZs) 16, 23, and 24 were combined during 2015 BpS Review. The primary difference between the original models was in the s-class mapping rules, which did not entirely comply with LANDFIRE mapping rules. S-class rules from MZ23 were used in the combined description because they were corrected to better comply with LANDFIRE rules.

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**

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

Description

Herbaceous vegetation is the dominant lifeform. Herbaceous cover is variable but typically >50% (50-80%). Shrub cover is 0-5%.

*Maximum Tree Size Class*  
None

Class B 48 Mid Development 1 - Open

Indicator Species

Description

Shrubs are the dominant lifeform. Mountain big sagebrush cover is up to 20%. Herbaceous cover is typically >50%. Initiation of conifer seedling establishment.

*Maximum Tree Size Class*  
Seedling <4.5ft

Class C 13 Late Development 1 - Closed

Indicator Species

Description

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

*Maximum Tree Size Class*  
None

Class D 11 Late Development 1 - Open

Indicator Species

Description

Conifers are the dominant lifeform (juniper, pinyon-juniper, ponderosa pine, limber pine, or Douglas-fir). Shrub cover is generally decreasing but remains between 26-40%. Herbaceous cover is <30%.

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

Class E 6 Late Development 2 - Closed

Indicator Species

Description

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

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

Model Parameters

Deterministic Transitions

Probabilistic Transitions

References

Anderson, J.E. and R.S. Inouye 2001. Landscape-scale changes in plant species abundance and biodiversity of a sagebrush steppe over 45 years. Ecological Monographs 71: 531-556.

Blaisdell, J.P., R.B. Murray and E.D. McArthur. 1982. Managing Intermountain rangelands--sagebrush-grass ranges. Gen. Tech. Rep. INT-134. Ogden, UT: USDA Forest Service, Intermountain Forest and Range Experiment Station. 41 pp.

Brown, D.E., ed. 1982. Biotic communities of the American Southwest--United States and Mexico. Desert Plants: Special Issue. 4(1-4): 342 pp.

Burkhardt, W.J. and E.W. Tisdale. 1969. Nature and succession status of western juniper vegetation in Idaho. Journal of Range Management 22(4): 264-270.

Burkhardt, W.J. and E.W. Tisdale. 1976. Causes of juniper invasion in southwestern Idaho. Ecology 57: 472-484.

Crawford, J.A., R.A. Olson, N.E. West, J.C. Mosley, M.A. Schroeder, T.D. Whitson, R.F. Miller, M.A. Gregg and C.S. Boyd. 2004. Ecology and management of sage-grouse and sage-grouse habitat. Journal of Range Management 57: 2-19.

Cronquist, A., A.H. Holmgren, N.H. Holmgren and others. 1994. Intermountain flora: Vascular plants of the Intermountain West, U.S.A. Vol. 5. Asterales. New York: The New York Botanical Garden. 496 pp.

Hironaka, M., M.A. Fosberg and A.H. Winward. 1983. Sagebrush-Grass Habitat Types of Southern Idaho. University of Idaho Forest, Wildlife and Range Experiment Station, Bulletin Number 35. Moscow, ID. 44 pp.

Houston, D.B. 1973. Wildfires in northern Yellowstone National Park. Ecology 54(5): 1111-1117.

Innes, Robin J. 2017. Artemisia tridentata subsp. vaseyana, mountain big sagebrush. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory (Producer). Available: https://www.fs.fed.us/database/feis/plants/shrub/arttriv/all.html [2017, December 23].

Johnson, K. 2000. Artemisia tridentata ssp. Vaseyana. In: Fire Effects Information System [Online], USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2004, September 17].

Miller, R.F. and L.L. Eddleman. 2000. Spatial and temporal changes of sage grouse habitat in the sagebrush biome. Technical Bulletin 151. Corvallis, OR: Oregon State University, Agricultural Experiment Station. 35 pp.

Miller, R.E. and N.L. Fowler. 1994. Life history variation and local adaptation within two populations of Bouteloua rigidiseta (Texas grama). Journal of Ecology. 82: 855-864.

Miller, R.F. and J.A. Rose. 1995. Historic expansion of Juniperus occidentalis (western juniper) in southeastern Oregon. The Great Basin Naturalist 55(1): 37-45.

Miller, R.F. and J.A. Rose. 1999. Fire history and western juniper encroachment in sagebrush steppe. Journal of Range Management 52: 550-559.

Miller, R.F., T.J. Svejcar and J.A. Rose. 2000. Impacts of western juniper on plant community composition and structure. Journal of Range Management 53(6): 574-585.

Miller, R.F. and R.J. Tausch. 2001. The role of fire in juniper and pinyon woodlands: a descriptive analysis. Proceedings: The First National Congress on Fire, Ecology, Prevention, and Management. San Diego, CA, Nov. 27- Dec. 1, 2000. Tall Timbers Research Station, Tallahassee, FL. Miscellaneous Publication 11: 15-30.

Mueggler, W.F. and W.L. Stewart. 1980. Grassland and shrubland habitat types of Western Montana. USDA Forest Service GTR INT-66.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of 10 February 2007.

Pedersen, E.K., J.W. Connelly, J.R. Hendrickson and W.E. Grant. 2003. Effect of sheep grazing and fire on sage grouse populations in southeastern Idaho. Ecological Modeling 165: 23-47.

Simon, S.A. 1990. Fire effects from prescribed underburning in central Oregon ponderosa pine plant communities: first and second growing season after burning. Pages 93-109 in: Fire in Pacific Northwest Ecosystems. T.E. Bedell, editor. Department of Rangeland Resources, Oregon State University, Corvallis, OR. 145 pp.

Tart, D.L. 1996. Big sagebrush plant associations of the Pinedale Ranger district. Pinedale, WY: USDA Forest Service. Bridger-Teton National Forest. Jackson, WY. 97 pp.

Welch, B.L. and C. Criddle. 2003. Countering Misinformation Concerning Big Sagebrush. Research Paper RMRS-RP-40. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 28 pp.

Winward, A.H. and E.W. Tisdale. 1977. Taxonomy of the Artemisia tridentata complex in Idaho. Bulletin Number 19. Moscow, ID: University of Idaho, College of Forestry, Wildlife and Range Sciences, Forest, Wildlife and Range Experiment Station. 15 pp.

Winward, A.H. 1991. A renewed commitment to management in sagebrush grasslands. Pages 2-7 in: Management in the Sagebrush Steppes. Oregon State University Agricultural Experiment Station Special Report 880. Corvallis OR.

Winward, A.H. 2004. Sagebrush of Colorado; taxonomy, distribution, ecology, & management. Colorado Division of Wildlife, Department of Natural Resources, Denver, CO.