

LANDFIRE Biophysical Setting Model

Biophysical Setting 0611260

Inter-Mountain Basins Montane Sagebrush Steppe

- ☐ This BPS is lumped with:
☐ This BPS is split into multiple models:

General Information

Contributors (also see the Comments field) **Date** 3/16/2005

Modeler 1 Gary Medlyn gary_medlyn@nv.blm.gov **Reviewer**

Modeler 2 Crystal Kolden ckolden@gmail.com **Reviewer**

Modeler 3 **Reviewer**

<u>Vegetation Type</u>	<u>Dominant Species</u>	<u>Map Zone</u>	<u>Model Zone</u>
Upland Savanna and Shrub-Steppe	ARTRV PUTR2	6	☐ Alaska California ☒ ☐ Great Basin ☐ Great Lakes ☐ Hawaii ☐ Northeast
General Model Sources	SYOR2		☐ Northern Plains N-Cent. Rockies ☐ ☐ Pacific Northwest ☐ South Central ☐ Southeast ☐ S. Appalachians ☐ Southwest
☒ Literature ☐ Local Data ☒ Expert Estimate			

Geographic Range

Montane and subalpine elevations across the western U.S. from 1000m in eastern Oregon and Washington to over 3000m in the southern Rockies, and within the mountains of Nevada, western Utah, southeast Wyoming, and southern Idaho.

Biophysical Site Description

This ecological system occurs in many of the western United States, usually at middle elevations (1000-2500m). Within the Great Basin mapping zone, elevation ranges from 1370m in Idaho to 3200m 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 1525-2750m in the mountains of Nevada and western Utah. The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 25-90 cm/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. 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.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

At lower elevations, mountain big sagebrush occurs on upper fan piedmonts, where it typically intermixes with Wyoming big sagebrush on north facing slopes. On mountain sideslopes at this elevation, it occurs on north-facing slopes and where pinyon and juniper is present, it is usually on south-facing slopes with pinyon and juniper generally increasing on north-facing slopes within the sagebrush community. At mid-level elevations, mountain sagebrush begins to move into more southerly slopes intermingling with black sagebrush and low sagebrush and with mountain mahogany occurring on north-facing slopes. With continued elevation, curlleaf mountain mahogany generally crowds it out. Mountain big sagebrush then occupies drier sites at higher elevations.

Vegetation Description

Vegetation types within this ecological system are usually less than 1.5 m 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*, *Ephedra viscidiflorus*, *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 *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*, *Bromus anomalus*, *Achnatherum therburianum*, *Poa fendleriana*, or *Poa secunda*. Forbs are often numerous and an important indicator of health. Forb species may include *Castilleja*, *Potentilla*, *Erigeron*, *Phlox*, *Astragalus*, *Geum*, *Lupinus*, and *Eriogonum*, *Balsamorhiza sagittata*, *Achillea millefolium*, *Antennaria rosea*, and *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.

Disturbance Description

Mean fire return intervals 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 mean return interval ranging from 40+yrs at the Wyoming big sagebrush ecotone, and up to 80 years in areas with a higher proportion of low sagebrush in the landscape (Crawford et al. 2004, Johnson 2000, Miller et al. 1994, 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. Therefore, replacement fire with a MFRI=40-80yrs was adopted here. 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 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 four years under favorable conditions and longer than 25yrs in unfavorable situations (Pedersen et al. 2003, Miller unpublished data). Mountain big sagebrush typically reaches 25% canopy cover in about 25yrs, but this may take as few as nine years or longer than 40yrs (Winward 1991, Pedersen et al.

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2003, Miller unpublished data). Mountain snowberry and resprouting forms of bitterbrush may return to pre-burn cover values in a few years. Bitterbrush plants less than fifty years old are more likely to resprout than older plants (Simon 1990).

Adjacency or Identification Concerns

In MZ16, BpS 1126 was separated into two very distinct montane sagebrush steppe not distinguished by NatureServe: Inter-Mountain Basins Montane Sagebrush Steppe dominated by mountain big sagebrush (1126big) and Inter-Mountain Basins Montane Sagebrush Steppe dominated by low sagebrush (1126low). Both systems cover large high-elevation areas in the Intermountain West. Mountain big sagebrush is a tall shrubs with MFRI=10-70yrs, whereas high-elevation low sagebrush is a dwarf shrub with a mean FRI of 200+ yrs. For MZs12 and 17, mountain big sagebrush communities fall into this model (BpS 1126), while mountain low sagebrush communities fall into BpS 1124.

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 predicted HRV and management.

This type may be adjacent to forests dominated by aspen, Douglas-fir, limber pine, and bristlecone pine. It also occurs adjacent to pinyon-juniper woodlands. The ecological system, where adjacent to conifers, is readily invaded by conifers (Douglas-fir, sub-alpine fir, whitebark pine, limber pine, pinyon-pine, 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.

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

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.

Native Uncharacteristic Conditions

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.

Issues/Problems

This was initially 1126a (Mountain Big Sagebrush) model from MZ16, which was itself based on RA models R2SBMT and R2SBMTwc where the 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 a MFI=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 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 FRG: II (modeler) vs. IV (reviewers). For MZs12 and 17, modelers place this system in Fire Regime Group IV.

****Fire Regime Groups are:** I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

If conifers are not adjacent to this system, such as in the Tuscarora range, Santa Rose range, and similar regions, use a three-box model with the following percentages per box: 20% A, 45% B, 35% C.

Comments

BPS 1126 for MZs06, 12 and 17 was based on BPS 1126a (Mountain Big Sagebrush) from LF MZ16. BpS 1126_a is essentially RA PNVG R2SBMTwc (mountain big sagebrush with potential for conifer invasion) developed by Don Major (dmajor@tnc.org), Alan R. Sands (asands@tnc.org), David Tart (dtart@fs.fed.us), and Steven Bunting (sbunting@uidaho.edu). R2SBMTwc was itself based on R2SBMT developed by David Tart. R2SBMTwc was revised by Louis Provencher (lprovencher@tnc.org) following critical reviews by Stanley Kitchen (skitchen@fs.fed.us), Michele Slaton (mslaton@fs.fed.us), Peter Weisberg (pweisberg@cabnr.unr.edu), Mike Zielinski (mike_zielinski@nv.blm.gov), and Gary Back (gback@srk.com).

The first three development classes chosen for this PNVG 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) phasestwo and three of pinyon and juniper invasion into shrublands.

Vegetation Classes

Class A 20 %

Early Development 1 Open

Upper Layer Lifeform

- ☒ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

1

Description

Indicator Species and Canopy Position

PSSP6
 Upper
 FEID
 Upper
 SYOR2
 Lower
 ARTRV
 Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	80 %
Height	Herb 0m	Herb 0.5m
Tree Size Class	None	

- ☒ Upper layer lifeform differs from dominant lifeform.

Dominant vegetation is herbaceous with scattered shrubs. Herbaceous cover is 0-80%.

Structural classes originally input as shrubs 0-5%, 0-.5 meters. However, due to mapping rules, and based on expert review, changed to herbaceous 0-80%, 0-.5 meters.

Herbaceous vegetation is the dominant lifeform. Herbaceous cover is variable but typically >50% (50-80%). Shrub cover is 0-5%. Replacement fire (MFRI=80yrs) setbacks succession by 12yrs. Succession to class B after 12yrs.

Structural classes originally input as shrubs 0-5%, 0-.5 meters. However, due to mapping rules, and based on expert review, changed to herbaceous 0-80%, 0-.5 meters.

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Class B 50 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
☒ Shrub
☐ Tree

Fuel Model

1

Description

Shrub cover 6-25%. Mountain big sagebrush cover up to 20%. Herbaceous cover is typically >50%. Initiation of conifer seedling establishment. Replacement fire MFRI=40yrs. Succession to class C after 38yrs.

Structural classes originally input as shrubs 6-25%. However, due to new breakpoints, changed to 0-20%.

Indicator Species and Canopy Position

ARTRV
 Upper
 PUTR2
 Upper
 CONIFER
 Lower
 SYMPH
 Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	20 %
Height	Shrub 0m	Shrub >3.1m
Tree Size Class	Seedling <4.5ft	

- ☒ Upper layer lifeform differs from dominant lifeform.

Herbaceous cover is the dominant lifeform with canopy >50%. Shrub cover is 6-25% and the upper lifeform.

Class C 15 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
☒ Shrub
☐ Tree

Fuel Model

2

Description

Shrubs are the dominant lifeform with canopy cover of 26-45+%. Herbaceous cover is typically <50%. Conifer (juniper, pinyon-juniper, ponderosa pine, or white fir) cover <10%. Insects and disease every 75yrs on average will thin the stand and cause a transition to class B. Replacement fire occurs every 50yrs on average. In the absence of fire for 80yrs, vegetation will transition to class D. Otherwise, succession keeps vegetation in class C.

Structural classes originally input as shrubs 26-45%. However, due to new breakpoints, changed to 21-50%.

Indicator Species and Canopy Position

ARTRV
 Upper
 PUTR2
 Upper
 SYMPH
 Low-Mid
 CONIFER
 Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	50 %
Height	Shrub 0m	Shrub >3.1m
Tree Size Class	None	

- ☐ Upper layer lifeform differs from dominant lifeform.

Class D 10 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
☐ Shrub
☒ Tree

Fuel Model

2

Description

Conifers are the upper lifeform (juniper, pinyon-juniper, ponderosa pine, limber pine, or white fir). Conifer

Indicator Species and Canopy Position

CONIFER
 Upper
 ARTRV
 Mid-Upper
 PUTR2
 Mid-Upper
 SYMPH
 Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	20 %
Height	Tree 0m	Tree 10m
Tree Size Class	Sapling >4.5ft; <5"DBH	

- ☒ Upper layer lifeform differs from dominant lifeform.

Shrub cover generally decreasing but remains between 26-40% Conifers cover 10-25%.

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cover is 11-25%. Shrub cover generally less than mid-development classes, but remains between 26-40%. Herbaceous cover <30%. The MFRI=50yrs. Insects/diseases thin the sagebrush, but not the conifers, every 75yrs on average, without causing a transition to other classes. Succession is from D to E after 50yrs.

Structural classes originally input as trees 10-25%. However, due to new breakpoints, changed to 11-20%.

Class E 5 % Late Development 2 Closed Upper Layer Lifeform ☐ Herbaceous ☐ Shrub ☒ Tree Fuel Model 6 Description	Indicator Species and Canopy Position CONIFER Upper ARTRV Mid-Upper PUTR2 Mid-Upper SYMPH Mid-Upper	Structure Data (for upper layer lifeform) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">Min</th> <th style="text-align: center;">Max</th> </tr> </thead> <tbody> <tr> <td>Cover</td> <td style="text-align: center;">21 %</td> <td style="text-align: center;">80 %</td> </tr> <tr> <td>Height</td> <td style="text-align: center;">Tree 0m</td> <td style="text-align: center;">Tree 10m</td> </tr> <tr> <td>Tree Size Class</td> <td colspan="2" style="text-align: center;">Pole 5-9" DBH</td> </tr> </tbody> </table> ☐ Upper layer lifeform differs from dominant lifeform.		Min	Max	Cover	21 %	80 %	Height	Tree 0m	Tree 10m	Tree Size Class	Pole 5-9" DBH	
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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 2000), juniper 26-40% (Miller and Rose 1999), white fir 26-80%). Shrub cover 0-20%. Herbaceous cover <20%. The mean FRI for replacement fire is longer than in previous states (75yrs). Conifers are susceptible to insects/diseases that cause diebacks (transition to class D) every 75yrs on average.

Structural classes originally input as trees 26-80%. However, due to new breakpoints, changed to 21-80%.

Disturbances

Fire Regime Group**: IV Historical Fire Size (acres) Avg 100 Min 10 Max 10000 Sources of Fire Regime Data ☒ Literature ☐ Local Data ☒ Expert Estimate Additional Disturbances Modeled ☒ Insects/Disease ☐ Native Grazing ☐ Other (optional 1) ☐ Wind/Weather/Stress ☐ Competition ☐ Other (optional 2)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Fire Intervals</th> <th style="text-align: center;">Avg FI</th> <th style="text-align: center;">Min FI</th> <th style="text-align: center;">Max FI</th> <th style="text-align: center;">Probability</th> <th style="text-align: center;">Percent of All Fires</th> </tr> </thead> <tbody> <tr> <td>Replacement</td> <td style="text-align: center;">49</td> <td style="text-align: center;">15</td> <td style="text-align: center;">100</td> <td style="text-align: center;">0.02041</td> <td style="text-align: center;">100</td> </tr> <tr> <td>Mixed</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Surface</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>All Fires</td> <td style="text-align: center;">49</td> <td></td> <td></td> <td style="text-align: center;">0.02043</td> <td></td> </tr> </tbody> </table> Fire Intervals (FI): Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.	Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires	Replacement	49	15	100	0.02041	100	Mixed						Surface						All Fires	49			0.02043	
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