LANDFIRE Biophysical Setting Model

Biophysical Setting 2311261 Inter-Mountain Basins Montane Sagebrush Steppe - Mountain Big Sagebrush

☐ *This BPS is lumped with:*

☑ *This BPS is split into multiple models: 1126_a is dominated by mountain big sagebrush and is FRG IV; 161126_b is dominated by low sagebrush and is FRG V.*

General Information

Contributors (also see the Comments field) **Date** 2/23/2005

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Vegetation Type
Upland Savannah/Shrub Steppe

Dominant Species
ARTRV
PUTR2
SYOR2

Map Zone
23

Model Zone
☐ Alaska
☐ California
☐ Great Basin
☐ Great Lakes
☐ Hawaii
☐ Northeast
☐ Northern Plains
☐ N-Cent.Rockies
☐ Pacific Northwest
☐ South Central
☐ Southeast
☐ S. Appalachians
☑ Southwest

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range

Montane and subalpine elevations across the western US from 1000m in eastern OR and WA to over 3000m in the southern Rockies.

Biophysical Site Description

This ecological system occurs in many of the western states, usually at middle elevations (1000-2500m). Within the Great Basin region, elevation ranges from 1370m in ID to 3200m in the White Mountains of CA (Winward and Tisdale 1977, Blaisdell et al 1982, Cronquist et al 1994, Miller and Eddleman 2000). However, elevations are predominantly between 1525-2750m.

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 ridge tops 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.

**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.

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, or 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.

Disturbance Description

Mean fire return intervals 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 mean return interval 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 et al 1994, 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. Therefore, replacement fire with a FRI of 40-80yrs (mean of 50yrs) 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 (50-100yr) events.

Recovery rates for shrub canopy cover very widely in this type, depending post-fire weather conditions, sagebrush seed-bank survival, abundance of resprouting shrubs (eg, snowberry, bitterbrush) and size and severity of the burn. Mountain big sagebrush typically reaches five percent 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 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).

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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 (1126_a) and Inter-Mountain Basins Montane Sagebrush Steppe dominated by low sagebrush (1126_b). Both systems cover large high-elevation areas in the Intermountain West. Mountain big sagebrush is a tall shrub with a mean FRI from 10-70yrs, whereas high-elevation low sagebrush is a dwarf shrub with a mean FRI of 200yrs+. Subalpine and montane dwarf sagebrush types (ie, Rocky Mountain Alpine Dwarf Shrubland (1070) and Inter-Mountain Basins Montane Sagebrush Steppe-- Low Sagebrush (1126_b)) tend to occur adjacent to Inter-Mountain Basins Montane Sagebrush Steppe--Mountain Big Sagebrush (1126_a). 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 (ie, 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, 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, sub-alpine 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 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 amplexcaulis) on clayey soils.

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.

Native Uncharacteristic Conditions

Scale Description

This type occupies areas ranging in size from 10s to 10000s of acres. Disturbance patch size can also range from 10s to 1000s of acres. The distribution of past burns was assumed to consist of many small patches in the landscape.

Issues/Problems

Reviewers and modelers had very different opinions on the range of mean FRIs and mountain big sagebrush recovery times (see Welch and Criddle 2003). It is increasingly agreed upon that a MFI 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 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

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(reviewers).

Comments

This model is identical to the model for the same BpS in MZ16 (Utah High Plateaus) with minor descriptive changes based on peer review for MZ23 and MZ24. Inter-Mountain Basins Montane Sagebrush Steppe-- Mountain Big Sagebrush (BpS 1126_a) is essentially the Rapid Assessment 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) and 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).

If tree invasion is not possible due to high elevation, lack of tree seed sources, or soils, the Historic Range of Variability predicted by R2SBMT for classes A, B and C, respectively, is 20%, 45% and 35%.

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) phases 2 and 3 of pinyon and juniper invasion into shrublands.

Vegetation Classes

Class A 20 %

Early Development 1 Open

Upper Layer Lifeform

- [x] Herbaceous
- [ ] Shrub
- [ ] Tree

Fuel Model

1

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 1.0m
Tree Size Class	None	

- [x] Upper layer lifeform differs from dominant lifeform.

Dominant vegetation is herbaceous with scattered shrubs.

Description

Herbaceous vegetation is the dominant lifeform. Herbaceous cover is variable but typically >50% (50-80%). Shrub cover is 0-5%. Replacement fire has a mean FRI of 80yrs in this class. Succession to class B after 12yrs.

Class B 50 %

Mid Development 1 Open

Upper Layer Lifeform

- [ ] Herbaceous
- [x] Shrub
- [ ] Tree

Fuel Model

1

Indicator Species and Canopy Position

ARTRV Upper
PUTR2 Upper
CONIFER Lower
SYMPH Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	30 %
Height	Shrub 0.6m	Shrub >3.1m
Tree Size Class	Seedling <4.5ft	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

Shrubs are the dominant lifeform and shrub cover is 6-25%. Mountain big sagebrush cover is up to 20%. Herbaceous cover is typically >50%. Initiation of conifer seedling establishment. Replacement fire mean FRI

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is 40yrs. Succession to class C after 38yrs.

Class C 15 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

2

Indicator Species and Canopy Position

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

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	50 %
Height	Shrub 0.6m	Shrub >3.1m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Shrubs are the dominant lifeform. Shrub cover is 26-45%+. Herbaceous cover is typically <50%. Conifer seedlings and saplings (juniper, pinyon-juniper, ponderosa pine or Douglas-fir) cover <10%. Insects and disease occur every 75yrs on average and will thin the stand, causing 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, class C persists.

Class D 10 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

2

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	10 %	30 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Shrub cover generally decreasing but remains between 26-40%

Description

Conifers are the dominant lifeform (juniper, pinyon-juniper, ponderosa pine, limber pine or Douglas-fir). Conifer cover is 11-25%. Shrub cover is generally decreasing, but remains between 26-40%. Herbaceous cover is <30%. The mean FRI of replacement fire is 50yrs. Insects/diseases thin the sagebrush, but not the conifers, every 75yrs on average and do not cause a transition to another class. If replacement fire or insects/disease do not occur, succession is to E after 45yrs.

Class E 5 %

Late Development 2 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

6

Indicator Species and Canopy Position

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

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	80 %
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Conifers are the dominant lifeform (juniper, pinyon-juniper, ponderosa pine, limber pine or Douglas-fir).

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Conifer cover ranges from 26-80% (pinyon-juniper 36-80% (Miller and Tausch 2000), juniper 26-40% (Miller and Rose 1999), Douglas-fir 26-80%). Shrub coveris 0-20%. Herbaceous cover is <20%. The mean FRI for replacement fire is longer than in previous states (75yrs). Conifers are susceptible to insects/diseases that cause diebacks and a transition to class D every 75yrs on average.

Disturbances

Fire Regime Group:** IV

Historical Fire Size (acres)

Avg 100
Min 10
Max 10000

Sources of Fire Regime Data

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	50	15	100	0.02	100
Mixed					
Surface					
All Fires	50			0.02002	

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.

Additional Disturbances Modeled

- [x] Insects/Disease
- [ ] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

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.

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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.

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 For. Serv. Bridger-Teton National Forest. Jackson, WY. 97 pp.

Welch, B.L. and C. Criddle. 2003. Countering Misinformation Concerning Big Sagebrush. Research Paper

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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.

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