LANDFIRE Biophysical Setting Model

Biophysical Setting 1811250 Inter-Mountain Basins Big Sagebrush Steppe

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

General Information

Contributors (also see the Comments field) **Date** 5/19/2005

Modeler 1	Eric Limbach	eric_limbach@blm.gov	**Reviewer**	Jon Bates	jon.bates@oregonstate.edu
Modeler 2			**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type
Shrubland

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Dominant Species
ARTRW8
PSSP6
STTH2
POSE

Map Zone
18

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

Geographic Range
This widespread matrix-forming ecological system occurs throughout much of the Columbia Plateau and northern Great Basin and WY and is found at slightly higher elevations farther south.

Biophysical Site Description
Sagebrush steppe is found in continental, semi-arid climate with highly variable annual precipitation >7-12in (~180-300mm) (McArthur 2000) and in some locations up to 14in precipitation zone. Common on foothills, undulating terraces, slopes and plateaus, but also in basins and valley bottoms. Soil depths range from shallow to moderately deep, well-drained with an effective rooting depth of <40in (~1m). NRCS Range Sites: Loamy 8-10in and 10-12in precipitation zones, and shallow loam 10-14in precipitation zones.

Vegetation Description
This shrub-steppe is dominated by perennial grasses and forbs (>25% cover) with Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. wyomingensis and/or Purshia tridentata dominating or codominating the open to moderately dense (10-40% cover) shrub layer. In southern ID and northern UT, Artemisia tridentata ssp. wyomingensis dominates large landscapes. Atriplex confertifolia, Chrysothamnus viscidiflorus, Ericameria nauseosa or Tetradymia spp may be common especially in disturbed stands. Associated graminoids include Achnatherum hymenoides, Elymus lanceolatus ssp. lanceolatus, Festuca idahoensis, Festuca campestris, Koeleria macrantha, Poa secunda and Pseudoroegneria spicata. Common forbs are Phlox hoodii, Arenaria spp, Crepis spp, Erigeron spp, Eriogonum spp, Lomatium spp and Astragalus spp. Areas with deeper soils more commonly support Artemisia tridentata ssp. tridentata but have largely been converted for other land uses.

**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.

The sagebrush steppe landscape is a mosaic of shrub-dominated and herbaceous-dominated phases (West 2000). Forbs have low diversity but are important for wildlife, including the greater sage grouse. Species diversity is lower in Wyoming big sagebrush communities than in other big sagebrush types (FEIS). Wyoming big sagebrush communities are critical habitat for greater sage grouse and other sagebrush obligate species.

Disturbance Description

Historically, fire was the principal disturbance within this vegetation type; other disturbances included insects (eg, moths and grasshoppers that eat leaves, moth larval grubs that eat roots; return interval of 75yrs), periods of drought and wet cycles and shifts in climate (return interval of 100yrs). Intervals between natural wildfires varied between 25yrs (northern Yellowstone National Park [Houston 1973], cited in West 2000) and 100yrs+ (West 2000). West (1983) and Miller and Eddelman (2000) cite mean FRI <100yrs for replacement fire. FEIS cites fire return interval ranges between 10-70yrs with mean of 40yrs for Wyoming sagebrush steppe. Studies cited in FEIS may underestimate FRIs or not hold up to scrutiny (Welch and Criddle 2003). It was assumed that dominant fires were stand replacement (mean FRIs of 75-94yrs) due to the continuity of fine fuel typical of steppe ecosystems, however it is not uncommon to observe >50% bare ground cover in modern range sites that experience little livestock grazing (Jon Bates, personal communication, 5/31/05). Mixed severity (25-75% of area inside burn perimeter top killed) played a minor role during mid-development. Assuming a MFI of 75yrs (from the total fire probability), the mean FRI of mixed severity fire was 20% of fires, thus a mean FRI of 375yrs, during mid-development. Re-establishment following fire is from seed germination and establishment. Establishment is dependent upon soil seed bank and/or proximity of seed sources, fire size and continuity, and climatic conditions.

Adjacency or Identification Concerns

BpS 1125 represents the dominant sagebrush type in MZ18, however this type may be confused with BpS 1080 (Inter-Mountain Basins Big Sagebrush Shrubland) on the transition of the Great Basin and Columbia Plateau.

The NatureServe description of BpS 1125 includes different species of sagebrush and steppe ecosystems that are structurally and ecologically different such as Artemisia tridentata ssp. tridentata and Artemisia tridentata ssp. wyomingensis. We highly recommend that, at least, Artemisia tridentata ssp. tridentata, which is a taller shrub found in drainages and deeper soils, be separated from the other shrubs. Ultimately, the two sagebrush species should be modeled separately. Artemisia tripartita ssp. tripartita is not part of this system in NV because it is generally associated with frigid soils (thus more typically mountain big sagebrush) under snow pockets. Bitterbrush is not found in a large area of northcentral NV on the more alkaline soils of Pleistocene Lake Lahontan.

Wyoming big sagebrush is known to hybridize with other subspecies of the big sagebrush complex; ie, basin big sagebrush (A. tridentata ssp. tridentata) and mountain big sagebrush (A. tridentata ssp. vaseyana) (Freeman et al. 1991, McArthur et al. 1998). Across ecotones, populations of Wyoming big sagebrush probably intergrade with basin big sagebrush and mountain big sagebrush. Soils and elevation may help determine which species is present.

Invasion of cheatgrass has transformed this ecological system into large areas of uncharacteristic annual grasslands and shrublands with understories where annual grasses replaced perennial grasses. Medusahead, another exotic annual grass, is also becoming an issue in finer textured soils.

Native Uncharacteristic Conditions

**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.

Scale Description

Sagebrush steppe covers vast landscapes >10000ac with inclusions of low sagebrush and basin big sagebrush. Historic disturbance (fire) likely ranged from small (<10ac) to large (>10000ac) depending on conditions, surface wind speed, time since last ignition and fuel loading. An average patch size of 250ac was assumed.

Issues/Problems

West (2000) cites wide range in FRI (25-100yrs+). West (1983) and Miller and Eddelman (2000) recommend a FRI of <100 yrs for replacement fire. FEIS gives 10-70yr range (40yr average) (but see Welch and Criddle 2003). Current scientific opinion (Mike Pellant, BLM Range Ecologist on the Great Basin Restoration Initiative) puts the natural fire return interval at about 100yrs (confirmed by Stephen Bunting and Dave Pyke). Given uncertainties and opinions of reviewers, a MFI of 75yrs was chosen. Without this shorter MFI and differences in fire behavior, there would be no difference between Wyoming sagebrush steppe from the Snake River Plain and Wyoming big sagebrush semi-desert from central NV, UT, and eastern CA. Because replacement fire is by far dominant over mixed severity fire, a FRG IV was selected to the recommendation of reviewers.

Comments

D Major made changes to vegetation class structural values in response to MTD v3.1 updates (K Pohl 7/18/05 request). These changes have not been reviewed and accepted by model developers as of 7/24/05. BpS 1125 was accepted from the MZs 12 and 17 model (developed by Mike Zielinski, mike_zielinski@nv.blm.gov and Louis Provencher, lprovencher@tnc.org) with no changes by Eric Limbach.
Reviewer Jon Bates made several corrections. 1) Bare ground cover can reach 50-60% in Wyoming sagebrush steppe in good condition. The assumption of replacement fire only is based on continuous fuel, therefore it is possible that mixed severity fire was more frequent than assumed by the model with bare ground reaching 50-60% in some areas. This observation was not incorporated into the model although it already includes mixed severity fire. 2) Medusahead was added to the list of exotic species changing steppe composition in the western part of the BpS. 3) The more significant corrections were about the cover classes. Line-intercept, point-intercept, and Daubenmire plots in ID, northern NV and OR showed that Wyoming big sagebrush sites in good condition have an average cover of 12%, with 25% being infrequent and considered very high. The same sites sampled with wildlife sampling methods centered on greater sage grouse nest locations showed a doubling of sagebrush cover due simply to the method. Therefore, the cover breaks were reduced for class B and C: 6-15% and 15-30% (25% would be preferable based on data). Previous cover was 5-25% and 20-35% for these classes.

BpS 1125 for MZs 12 and 17 was obtained by slightly modifying the description of BpS 1125 for MZ16 developed by Don Major (dmajor@tnc.org). BpS 1125 for MZ16 is completely based on R2SBWYse developed by Eric Limbach (eric_limbach@blm.gov) for Wyoming big sagebrush steppe and reviewed by Krista Waid-Gollnick/Sarah Heidi (krista_waid@blm.gov), Stanley Kitchen (skitchen@fs.fed.edu), Michael Zielinski (mike_zielinski@nv.blm.gov), Jolie Pollet (jpollet@blm.gov) and Gary Back (gback@srk.com).

As a result of final QC for LANDFIRE National by Kori Blankenship the user-defined min and max fire return intervals for mixed severity fire were deleted because they were not consistent with the modeled fire return interval for this fire severity type.

**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 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
STTH2 Upper
POSE Upper
ARTRW8 Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	50 %
Height	Herb 0m	Herb 1.0m
Tree Size Class	None	

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

Vegetation is primarily herbaceous (>25% cover) with a few scattered shrubs accounting for less than five percent cover; height 0-1m. Originally modeled as shrub layer, but due to mapping rules, changed to herb layer.

Description

Perennial grasses and/or forbs dominate where woody shrub canopy has been top killed/removed by wildfire. Shrub cover less than six percent. (approx. 0-19yrs). Replacement fire every 120yrs on average. Succession to class B after 20yrs, although in reality this age will vary greatly.

Class B 50 %

Mid Development 1 Open

Upper Layer Lifeform

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

Fuel Model

1

Indicator Species and Canopy Position

PSSP6 Lower
STTH2 Lower
ARTRW8 Upper
POSE Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	20 %
Height	Shrub 0m	Shrub 1.0m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

Shrubs dominate (5-15% cover) with diverse perennial grass and forb understory (20-60yrs). MFI is 75yrs with 80% replacement fire (mean FRI of 94yrs) and 20% mixed severity fire (mean FRI of 375yrs). Mixed severity fire, insect/disease (return interval of 75yrs), and weather related stress (return interval of 100yrs) maintains vegetation in class B. Succession to class C after 40yrs.

Class C 30 %

Late Development 1 Closed

Upper Layer Lifeform

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

Fuel Model

2

Indicator Species and Canopy Position

ARTRW8 Upper
PSSP6 Lower
STTH2 Lower
POSE Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	30 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

Mature shrub canopy >15% cover with proportional reduction in understory productivity as canopy cover increases. The mean FRI for replacement fire is 75yrs. Insect/diseases (return interval of 75yrs), and weather

**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.

related stress (return interval of 100yrs) thin the shrub canopy, causing a transition to class B. Succession from class C to C.

Class D **0 %**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Indicator Species and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class E **0 %**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Indicator Species and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

Disturbances

Fire Regime Group:** **IV**

Historical Fire Size (acres)

Avg 250
Min 10
Max 10000

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	92	30	120	0.01087	89
Mixed	714			0.00140	11
Surface					
All Fires	81			0.01228	

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

☑ Insects/Disease ☐ Native Grazing ☐ Other (optional 1)
☑ Wind/Weather/Stress ☐ Competition ☐ Other (optional 2)

References

Brown, J.K. and J. Kapler-Smith, eds. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 257 pp.

**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.

Freeman, D.C., W.A. Turner, E.D. McArthur and J.H. Graham. 1991. Characterization of a narrow hybrid zone between two subspecies of big sagebrush (Artemisia tridenta: Asteraceae). American Journal of Botany. 78(6): 805-815.

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

Howard, J.L. 1999. Artemisia tridentata subsp. wyomingensis. 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/ [2007, August 27].

McArthur, E.D., D.C. Freeman and J.H. Graham. 1998. Narrow hybrid zone between two subspecies of big sagebrush (Artemisia tridentata: Asteraceae). VI. Respiration and water potential. Canadian Journal of Botany. 76(4): 567-574.

McArthur, E.D. 2000. Sagebrush systematics and distribution. Pages 9-14 in: P.G. Entwhistle, A.M. DeBolt, J.H. Kaltenecker and K. Steenhof, compilers. Proceedings: Sagebrush Steppe Ecosystems Symposium. Bureau of Land Management Publication No. BLM/ID/PT-001001+1150, Boise, Idaho, USA.

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

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

Peters, E.F. and S.C. Bunting. 1994. Fire conditions pre- and post-occurrence of annual grasses on the Snake River plain. Pages 31-36 in: Proceedings - Ecology, management, and restoration of Intermountain rangelands symposium. USDA Forest Service INT-GTR-313, Ogden, Utah.

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.

West, N.E. 1983. Western Intermountain sagebrush steppe. Pages 351-395 in: N.E. West, ed. Ecosystems of the World 5: Temperate deserts and semi-deserts. Elsevier Scientific Publishing Co., New York, NY.

West, N.E. 2000. Synecology and disturbance regimes of sagebrush steppe ecosystems. Pages 15-26 in: P.G. Entwhistle, A.M. DeBolt, J.H. Kaltenecker and K. Steenhof, compilers. Proceedings: Sagebrush Steppe Ecosystems Symposium. Bureau of Land Management Publication No. BLM/ID/PT-001001+1150, Boise, Idaho, USA.

Whisentant, S.G. 1990. Changing fire frequencies on Idaho's Snake River plains: Ecological and management implications. Pages 4-10 in E.D. McArthur, E.M. Romme, S.D. Smith and P.T. Tueller, eds. Proceedings of a symposium on cheatgrass invasion, shrub die-off, and other aspecys of shrub biology and management. USDA Forest Service Gen. Tech. Rep. INT-276. Intermountain Forest and Range Experiment Station, Ogden, Utah.

**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.