

10800

Inter-Mountain Basins Big Sagebrush Shrubland

BpS Model/Description Version: Aug. 2020

Modelers		Reviewers	
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Vegetation Type

Shrubland

Map Zones

1, 7, 8, 9

Geographic Range

This Biophysical Setting (BpS) occurs in central Washington, Pasco Basin, and similarly low-lying areas of the Columbia Plateau in Washington, and likely occurs in northern Oregon along the Columbia and Snake rivers. Additionally, the type can be found further south in the Blue Mountains and Northern Great Basin ecoregions (US EPA 2013).

Biophysical Site Description

This BpS occurs in the warmest and driest portions of the Columbia Plateau. Soils vary from silt-loam to sandy to lithic, although surface rock is uncommon in the lithic soil types. Average annual precipitation is ~6-7in, falling primarily as winter rain.

This BpS largely occurs at low elevations (400-800ft) in central Washington but may be as high as 3,000ft in other parts of the Columbia Basin.

Vegetation Description

Wyoming big sagebrush is the primary species. Spiny hopsage is often associated with the Wyoming big sagebrush and occasionally co-dominant or dominant. Basin big sagebrush is uncommon and limited to the most mesic sites.

Sandberg's bluegrass is the primary herbaceous species. Large bunchgrasses are generally absent except on sandy soils where needle-and-thread and Indian ricegrass occur. Forbs are relatively sparse and species richness relatively low compared to other big sagebrush BpSs.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
ARTRW 8	<i>Artemisia tridentata ssp. wyomingensis</i>	Wyoming big sagebrush
GRSP	<i>Grayia spinosa</i>	Spiny hopsage
POSE	<i>Poa secunda</i>	Sandberg bluegrass

BACA3	<i>Balsamorhiza careyana</i>	Carey's balsamroot
HECO26	<i>Hesperostipa comata</i>	Needle and thread
ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass

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

Disturbance Description

Lightning fires are relatively rare due to a combination of a low number of strikes relative to surrounding areas and accompanying rain that often extinguishes starts. The BpS typically lacks the fine fuel needed to help fires start and spread readily. Nonetheless, fires did occur occasionally and could burn large areas, usually driven by wind. The fire regime was characterized by relatively infrequent patchy replacement fires due to highly variable fine fuels. Many fires may have been small in size (<100ac) and not as ecologically significant as fires >100ac. These larger fires were more likely following wetter-than-average years with higher-than-average grass loadings.

Shrub die-offs have occurred in the late 20th century in this type, but the causes are largely unknown. Whether similar die-offs were characteristic of the historical conditions is also unknown.

Aroga Moth:

Several species of insects feed on big sagebrush, although only a few species have been documented as causing reductions in canopy cover and sagebrush mortality. The Aroga moth (*Aroga websteri*), a defoliator, is the best known and is capable of defoliating large areas (i.e., >1000ac), but usually outbreaks range from 10-100ac. Aroga moth outbreaks either kill or thin older sagebrush classes. Sagebrush mortality is somewhat more likely on southerly aspects, although defoliation may be greater on northerly aspects and in sites with higher sagebrush cover and large shrubs. Aroga moth outbreaks are more prevalent in the northern Great Basin. It is debatable whether the moth's outbreaks are a significant factor in central Nevada. Aroga moth outbreaks are more prevalent in lower-elevation sagebrush (where there are less flowering plants and nectar to feed the parasitic wasps that attack the moth) and during years when the months of May, June, and July are substantially wetter and warmer than average (Bolshakova and Evans 2014, 2016). The return interval of moth outbreaks is ~15yrs in southern Idaho and Oregon and northern Nevada and Utah based on the examination of the Standard Precipitation Index for June lagged for two months (i.e., May and June) of the same year.

Drought:

This BpS is prone to multi-year droughts instead of single year droughts. Periodic drought may have reduced the density and cover of sagebrush by reducing canopy size and killing individual plants. However, droughts that affect the entire area where this BpS occurs are rare, with subregional droughts more common. Area-wide droughts are typically prolonged (>4yrs) and very severe, while subregional droughts are shorter (2-4yrs) and less severe. The size of the area affected by subregional drought would vary from 10,000s to 100,000s of acres and sagebrush mortality may be related to soil type.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	100	100		

Moderate (Mixed)				
Low (Surface)				
All Fires	100	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 community occurs in the 1,000s to 10,000s of acres; disturbances could affect large areas.

Adjacency or Identification Concerns

This type can easily be confused with the late-seral closed canopy stage of Inter-Mountain Basins Big Sagebrush Steppe (1125), particularly since fire exclusion, grazing, and other land use practices have resulted in a shift toward the late seral closed canopy stage in that BpS. However, from the ground level, large bunchgrasses, particularly bluebunch wheatgrass, are generally absent from this BpS.

The Inter-Mountain Basins Big Sagebrush Steppe occurs adjacent to and intergrades with this BpS. Inter-Mountain Basin Sparsely Vegetated Systems, particularly the Active and Stabilized Dune formation, co-occurs with this type. At the dryer margins, it integrates and borders Mixed Salt Desert Shrub.

Issues or Problems

Past over-grazing allowed invasive annual grasses, mostly cheatgrass, to establish within this BpS. Cheatgrass has fueled larger and more frequent fires than occurred historically and is resulting in a type conversion.

Grazing probably also contributed to an increasing density of large shrubs and reduction of perennial grasses.

Spiny hopsage has only rarely been observed to reproduce in central Washington over the last 50yrs, basically since observations began.

The scope, scale, and purpose of any burning by Native Americans is not known.

Native Uncharacteristic Conditions

If >40% shrub cover is present, then another BpS is present.

Comments

Alan Sands and Andrea Laliberte reviewed this model during the BpS Review. Sands generally concurred with the model description but recommended several modifications:

1. Sands suggested that the fire frequency, which was ca.30yrs, should be reduced to >100 years given the sparse herbaceous cover available to carry fire and to make it more consistent with the Great Basin version of this model (10801-6-12-16-17-18-23-24), and he suggested that mixed-severity fire should not be included in the model. Sands felt that although some burns were patchy, fire would always kill fire sensitive sagebrush.

Kori Blankenship did eliminate mixed fire in the model, making the model consistent with the Great Basin version of this BpS (10801-6-12-15-16-17-18-23-24-25) as well as the Columbia Basin/Northern Great Basin Sagebrush Steppe model (BpS 11250-1-7-8-9-

10-19). In addition, the use of mixed fire in this model was inconsistent with the LANDFIRE fire severity definitions, which define mixed-severity as a fire that top-kills 25-75% of the upper-layer lifeform and a replacement fire severity as one that top-kills >75% of the upper-layer lifeform. Wyoming big sagebrush is killed by fire according to the FEIS species review for the plant (Howard 1999), and therefore, fires in this system meet the LANDFIRE criteria for replacement fire.

Blankenship effectively reduced the overall fire frequency by eliminating mixed-severity fire in the model. This resulted in the BpS having a longer fire return interval than the Columbia Basin/Northern Great Basin Sagebrush Steppe model (BpS 11250-1-7-8-9-10-19), which was appropriate given that Sagebrush Shrubland is more fuel-limited than the Sagebrush Steppe. There was also an indication that the modelers of this type may have modeled fire more frequently than they intended. The original description stated that “although the fire return interval suggests fire regime II, this was a mixed severity regime with relatively infrequent fire due to highly variable fine fuels.”

An outstanding question that should be evaluated in the future is whether patchy replacement fires that maintain the model states (e.g., Late to Late replacement fire) should be represented in the model.

2. Sands suggested the addition of insect disturbance to the model. This recommendation was consistent with reviewer comments about the importance of aroga moth for this same BpS in the northern Great Basin and for the Sage Steppe BpS (11250-1-7-8-9-10-19). Blankenship implemented this suggestion by adding text to the disturbance description about aroga moth from the Columbia Plateau/Northern Great Basin Sage Steppe (11250-1-7-8-9-10-19) and the Great Basin Big Sagebrush Shrubland (10800-6-12-15-16-17-18-23-24-25) models. Model transitions and probabilities were suggested by Louis Provencher and are described below.

The return interval of moth outbreaks was estimated at ~15yrs (rate = 0.0667/yr) in southern Idaho and Oregon and northern Nevada and Utah based on the examination of the Standard Precipitation Index for June lagged for two months (i.e., May and June) of the same year. This probability was partitioned as follows:

-Outbreaks that thin sagebrush were estimated to apply to 75% of pixels. The probability for thinning was calculated as the overall outbreak probability (.0667) times the percentage (.75), resulting in a thinning probability of .0500.

-Outbreaks that completely kill sagebrush were estimated to apply to 25% of pixels. The probability for mortality was calculated as the overall outbreak probability (.0667) times the percentage (.25), resulting in a mortality probability of .0167.

3. Sands suggested the addition of wind/weather disturbance to represent drought in the model. This recommendation was consistent with reviewer comments for the Sage Steppe BpS (11250-1-7-8-9-10-19). Blankenship implemented this suggestion by adding text to the disturbance description about drought copied from the Sage Steppe BpS (11250-1-7-8-9-10-19) and using the same probabilistic transitions from that model in this one.

4. Sands stated that the maximum cover for this BpS should be 30% rather than 40%. Blankenship did not change the maximum cover, noting that 40% was consistent with the Great Basin version of this BpS (10801-6-12-16-17-18-23-24).

Both Sands and Laliberte suggested that this model should be represented by a three-state, rather than four-state model. The four-state model was inconsistent with other models where the fourth state was used to represent tree invasions, which does not occur in this geography. Also, the four original states defined for the BpS had very similar structure, making them difficult to map. Blankenship implemented this suggestion by combining the Late Open and Late Closed classes into a single Late Closed class. This change made the model consistent with the Great Basin version of this model (10801-6-12-15-16-17-18-23-24-25) and should improve the mappability of the classes.

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:

- Has LANDFIRE appropriately identified and classified the big sage shrubland (BpS 10800) relative to big sage steppe (BpS 11250)? In his system-wide review of these BpSs, Alan Sands indicated that what was mapped and modeled as Big Sage Shrubland should be Big Sage Steppe in the following MZs: 10, 19, 21, 22, 31, and 33. Kori Blankenship consulted NatureServe range maps to evaluate this suggestion and found that they reported Big Sage Shrubland occurring in all these zones. Blankenship felt that more input was needed from local ecologists and NatureServe on the distribution of the types and the distinctions between them before changing the classification. This suggestion should be considered in future review.
- What is an appropriate fire frequency and severity for this BpS? Estimates for these fire regime parameters vary widely, and during LANDFIRE National, there was considerable debate about these values in some areas (see 10801-21-22-28 and 10802-21-22-28).
- Does the Wyoming big sagebrush versus basin big sagebrush split applied in the model representing MZs 21, 22, and 28 apply elsewhere, and can it be successfully mapped from 30m imagery? Descriptions for this BpS in some other zones indicated a need for distinct BpS models and mapping units for the different big sagebrush subspecies, but questions arose about the ability to map the distinctions from satellite imagery.
- Does the upland versus semi-desert split applied in the model representing MZs 06, 12, 15, 16, 17, 18, 23, 24, and 25 apply elsewhere? The split helps distinguish differences in species, fire frequency, and management options for sites on upland soils that receive enough precipitation to support trees from semi-desert sites that cannot.

MZs 01, 07, 08, and 09 were combined during 2015 BpS Review. The primary difference between the original models was in the s-class mapping rules, which did not comply with LANDFIRE mapping rules in MZs 01, 08, and 09.

In the model, wind/weather/stress transitions represent drought and insects/disease represent the aroga moth

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	A	A	B	UN	UN	UN	UN	UN	UN	UN
Herb	0.5-1.0	A	A	B	UN	UN	UN	UN	UN	UN	UN
Herb	>1.0	A	A	B	UN	UN	UN	UN	UN	UN	UN
Shrub	0-0.5	B	B	C	C	UN	UN	UN	UN	UN	UN
Shrub	0.5-1.0	B	B	C	C	UN	UN	UN	UN	UN	UN
Shrub	1.0-3.0	B	B	C	C	UN	UN	UN	UN	UN	UN
Shrub	>3.0	B	B	C	C	UN	UN	UN	UN	UN	UN
Tree	0-5	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Tree	5-10	UN	UN	UN	UN	UN	UN	UN	UN	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 19 Early Development 1 - All Structures

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
POSE	<i>Poa secunda</i>	Sandberg bluegrass	Low-Mid
HECO26	<i>Hesperostipa comata</i>	Needle and thread	Upper
AMSIN	<i>Amsinckia</i>	Fiddleneck	Middle
EPILO	<i>Epilobium</i>	Willowherb	Middle

Description

This class is dominated by herbs with canopy closure up to 10%. Typical species include Sandberg's bluegrass with needle-and-thread and Indian ricegrass on sandy soils and perennial forbs such as Carey's balsamroot and native annual forbs.

Maximum Tree Size Class

None

Class B 52 Mid Development 1 - Open

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
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POSE	Poa secunda	Sandberg bluegrass	Low-Mid
ARTRW8	Artemisia tridentata ssp. wyomingensis	Wyoming big sagebrush	Upper
GRSP	Grayia spinosa	Spiny hopsage	Mid-Upper
HECO26	Hesperostipa comata	Needle and thread	Upper

Description

Small, scattered sagebrush and spiny hopsage are now present, although canopy cover from shrubs is generally <10%. Dominant lifeform is herbaceous with cover ranging from 11-20% and a maximum height of 0.5m. Sandberg's bluegrass remains the dominant grass species on most soils. Forbs are well established and essentially mature with cover of <10%. Total vegetation cover is generally 25% or less. Biological soil crust is reforming, but large amounts of bare ground remain.

Maximum Tree Size Class

None

Class C 29 Late Development 1 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ARTRW8	Artemisia tridentata ssp. wyomingensis	Wyoming big sagebrush	Upper
GRSP	Grayia spinosa	Spiny hopsage	Upper
POSE	Poa secunda	Sandberg bluegrass	Lower
HECO26	Hesperostipa comata	Needle and thread	Mid-Upper

Description

Generally, after ~80yrs, the site supports the maximum cover it can but is still generally <40% cover overall. Shrubs comprise most of this cover, with grasses and forbs contributing a minor amount. Biological soil crusts are fully developed with relatively few areas of bare soil.

Maximum Tree Size Class

None

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:OPN	14
Mid1:OPN	15	Late1:CLS	34
Late1:CLS	35	Late1:CLS	999

Probabilistic Transitions

Disturbance Type	Disturbance occurs In	Moves vegetation to	Disturbance Probability	Return Interval (yrs)	Reset Age to New Class Start	Years Since Last Disturbance
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					Age After Disturbance?	
Replacement Fire	Early1:ALL	Early1:ALL	0.01	100	Yes	0
Wind or Weather or Stress	Mid1:OPN	Mid1:OPN	0.0065	154	No	0
Replacement Fire	Mid1:OPN	Early1:ALL	0.01	100	Yes	0
Wind or Weather or Stress	Late1:CLS	Mid1:OPN	0.0065	154	Yes	0
Replacement Fire	Late1:CLS	Early1:ALL	0.01	100	Yes	0
Insects or Disease	Late1:CLS	Early1:ALL	0.0167	60	Yes	0
Insects or Disease	Late1:CLS	Mid1:OPN	0.05	20	Yes	0

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