

10802

Inter-Mountain Basins Big Sagebrush Shrubland - Wyoming Big Sagebrush

BpS Model/Description Version: Aug. 2020

Modelers		Reviewers	
Steve Kilpatrick (model input)	Steve.Kilpatrick@wgf.state.wy.us	Dave Tart	dtart@fs.fed.us
		Stan Kitchen	skitchen@fs.fed.us

Reviewer: Alan Sands

Vegetation Type

Shrubland

Map Zones

21, 22, 28

Model Splits or Lumps

This Biophysical Setting (BpS) is split into multiple models. Wyoming Big Sagebrush and Basin Big Sagebrush variants were split out from the Inter-Mountain Basins Big Sagebrush Shrubland to represent differences in the fire regimes, floral composition, and biophysical sites.

Basin big sagebrush is found at lower elevations and is usually restricted to comparatively moist ravines or valleys (Barker and McKell 1983 in Knight 1994). It also grows taller than any other species of *Artemisia* (up to 2m or more). Basin big sagebrush is more common on sandy soils, and Wyoming big sagebrush is more common on fine-textured soils (Knight 1994). Basin big sagebrush tends to grow in deeper, more fertile soils with greater moisture availability compared to Wyoming big sagebrush sites. Basin big sagebrush is an indicator of productive sites.

Wyoming big sagebrush is the most common shrub of the intermountain basins. It is normally <0.5 m tall and occupies drier upland sites with basin big sage occurring in adjacent ravines (Knight 1994). It tends to grow on shallower, well-drained, and xeric soils when compared to mountain and basin big sagebrush (Barker and McKell 1983). When Wyoming big sagebrush occurs with black, longleaf (*A. longiloba*) and threetip sagebrush communities, it often occupies relatively deeper soils (Tweit and Houston 1980). Where Wyoming, basin, and mountain big sagebrush ranges overlap, Wyoming big sagebrush tends to grow on shallowest, most well-drained, and hottest soils relative to the other two subspecies.

Geographic Range

This BpS is wide-ranging: common to Basin and Range province, extending into the Columbia Plateau and east into the northern and central Rockies to the western edge of the shortgrass prairie. This particular model focuses on the Wyoming Basins, Middle Rockies, and Southern Rockies ecoregions (Cleland et al. 2007).

Biophysical Site Description

Wyoming big sagebrush occupies foothills, terraces, slopes, plateaus, and basin edges. Soils are shallow to moderately deep and well drained. Wyoming big sagebrush tends to grow on shallower, well-drained, and xeric soils when compared to mountain and basin big sagebrush (Barker and McKell 1983). When Wyoming big sagebrush occurs with black, longleaf (*A. longiloba*) and threetip sagebrush communities, it often occupies the relatively deeper soils (Tweit and Houston 1980).

Wyoming big sagebrush generally occurs in the 5-14in precipitation zones. In Wyoming, a considerable amount of Wyoming big sagebrush occurs in the 5-9in and the 10-14in precipitation zones. Soil depth and accumulation of snow enhance these communities in lower precipitation zones (Knight 1994).

In Wyoming, this type is typically found from 5,000-7,000ft (1,500-2,100m) in elevation.

Vegetation Description

Wyoming big sagebrush is the dominant mid-to late seral species within this plant assemblage. Associated shrubs and shrub-like species can be small green rabbitbrush, black sagebrush, spiny hopsage, winterfat, and broome snakeweed. In Montana, rubber rabbitbrush (*Ericameria nauseosa*) and prairie sagewort (*Artemisia frigida*) are consistently present in amounts <5%, unless the community has experienced abusive grazing.

Cool season grasses such as Indian ricegrass, bluebunch wheatgrass, needle-and-thread, blue grama, Sandberg bluegrass, and squirreltail are common. Thurber's needlegrass is found less frequently. Rhizomatous wheatgrasses, such as western wheatgrass, are common species within map zone (MZ) 22. In MZ 21, thickspike wheatgrass (*Elymus lanceolatus*) is conventionally the dominant and diagnostic graminoid, though in exceptionally mesic representations it may have less cover than green needlegrass (*Nassella viridula*). Other important associated graminoids in MZ21 include prairie Junegrass (*Koeleria macrantha*) and threadleaf sedge (*Carex filifolia*).

Total forb cover is low while the more constant species are *Sphaeralcea coccinea*, *Vicia americana*, *Achillea millefolium*, and *Opuntia polyacantha*. Other common forbs are species of *Astragalus*, *Crepis*, *Delphinium*, *Phlox*, and *Castilleja*.

Herbaceous species usually dominate the site prior to reestablishment. Site reestablishment is by seed bank, seed production from remnant plants, and seeds from adjacent plants. Cryptobiotic organisms (*Vesicular arbuscular mycorrhiza*) are important (Howard 1999).

Wyoming big sagebrush sites have fewer understory species relative to other big sagebrush subspecies, though at higher elevations or moister areas of this vegetation community, there is a higher potential for herbaceous species. On the southeastern side of MZ22, in subsections 342 Fj, 342Fl, 342Fi, 342Ff, and 331Gb (Cleland et al. 2007), herbaceous cover increases transitioning into the shortgrass prairie.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
ARTRW 8	<i>Artemisia tridentata ssp. wyomingensis</i>	Wyoming big sagebrush
PSSP6	<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass
POSE	<i>Poa secunda</i>	Sandberg bluegrass
CHRY9	<i>Chrysothamnus</i>	Rabbitbrush
STAC	<i>Stenotus acaulis</i>	Stemless mock goldenweed
PHHO	<i>Phlox hoodii</i>	Spiny phlox
FEID	<i>Festuca idahoensis</i>	Idaho fescue
ELLA3	<i>Elymus lanceolatus</i>	Thickspike wheatgrass

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

Disturbance Description

Many researchers believe fire was the primary disturbance factor within this plant assemblage. Other disturbance factors may include insects, rodents, and lagomorphs, drought, wet cycles, gradual changes in climate, and native grazing by large ungulates (e.g. bison) and insects (Wyoming Interagency Vegetation Community 2002). Drought may have been a more significant disturbance than native grazing or insects.

Following fire or other significant disturbance, herbaceous species will dominate the site, and recovery to pre-disturbance canopy cover is quite variable and may generally take 50-120yrs but occasionally occurs within a decade (Baker 2006). Site reestablishment is by seed bank, seed production from remnant plants, and seeds from adjacent plants. Discontinuity of fuel in Wyoming big sagebrush communities can result in mosaic burn patterns, leaving remnant plants for seed, but can be large expanses of complete mortality (Bushey 1987; Baker 2006). Fire does not stimulate germination of soil-stored Wyoming big sagebrush, but neither does it inhibit its germination (Champlin and Winward 1982). Regeneration may occur in pulses linked to high-precipitation events (Maier et al. 2001).

There was considerable debate between model contributors about the fire frequency and severity for this BpS. Estimates and comments on the fire regime included:

- A 1999 literature review reported a 10-70yr fire return interval for Wyoming big sagebrush (Howard 1999).
- Baker (2006) estimated a fire rotation of 100-240yrs or more (Baker 2006) for Wyoming big sagebrush.
- Other cited intervals for Wyoming big sagebrush were between 50-100yrs (Miller and Eddleman 2001; Miller et al. 1994; Wright and Biley 1982; Whisenant 1990; Miller and Tausch 2001) and up to 110yrs (West 1999; Whisenant 1990).
- Post-fire recovery to 20% canopy cover from a burn may take >40yrs (Winward 1991).
- Bunting et al. (1987) found that the average recovery time following fire in Wyoming big sagebrush communities was 30yrs.

The LANDFIRE Rapid Assessment model for this type had a mean fire return interval (MFRI) of 90yrs. There was disagreement among contributors, and estimates of the MFRI varied from 90-140 years, but most contributors agreed with the 90yr interval.

- LANDFIRE National reviewers for MZ22 felt that a 130yr interval was justified, as Wyoming big sagebrush does not reestablish for multiple decades, and fire was therefore likely infrequent (Eve Warren, personal communication).
- Stan Kitchen (personal communication) stated that we have no means to accurately measure historic fire frequency in sagebrush communities and that there are conflicting opinions as to the approaches taken to determine the fire frequency for these systems. Based on what has been shown through different approaches and field experience of those who know the system, the estimate of total MFRI for Wyoming big sagebrush steppe (productive) is between 60-120yrs and 75-200yrs for Wyoming big sagebrush shrubland. Modelers really don't know how fire might have behaved across the fuel threshold at the forest/shrubland ecotone. Therefore, it is not known how accurately proxy fire chronologies derived from fire-scarred trees predict fire regimes in nearby shrublands.

After an extensive model review process, LANDFIRE leadership/guidance determined that a ca.100yr MFRI for this BpS was reasonable based on available literature and aligned with the estimates of most of the model contributors.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	98	100	80	240
Moderate (Mixed)				
Low (Surface)				
All Fires	98	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

Occurrences may cover 1,000s of hectares.

Adjacency or Identification Concerns

This type merges into various other types, and Wyoming big sagebrush may hybridize with mountain sagebrush and basin big sagebrush. Local data show that hybridized taxa may have more resiliency to prescribed fire than nonhybridized Wyoming big sagebrush (Eve Warren, Wyoming BLM).

Secondary shrub and herbaceous components may vary considerably across the range of its extent. Wyoming big sagebrush sites may be a mosaic with or about juniper, limber pine-juniper, ponderosa pine, mountain sagebrush, salt desert shrub, and grassland vegetation types across its range.

Cheatgrass now dominates the herbaceous layers of many Wyoming big sagebrush communities, creating more frequent fire regimes. Broom snakeweed and *Halogeton* may dominate sites disturbed by overgrazing, oil and gas development, or other disturbances.

Juniper invasion into Wyoming big sagebrush systems could possibly be occurring in some locations today, but this does not appear to be a common occurrence in this MZ. In some cases, apparent invasions are simply recovery from past fires or temporary fluctuations along ecotones (Mark Williams, personal communication; anonymous contributor).

Issues or Problems

It is difficult to identify where hybrids occur with other big sagebrush taxa.

Native Uncharacteristic Conditions

Some reviewers indicated that canopy cover of Wyoming big sagebrush for this type would not exceed 40% while others thought it could be up to 60%.

Comments

In 2017, Alan Sands reviewed all Big Sagebrush Shrubland BpS descriptions and models. Sands comment on the MZ21 and MZ22 models included the following:

- Sands suggested that MZs 21 and 22 were similar ecologically, had similar descriptions, and should be represented by the same model. Blankenship noted that the models for these zones had identical s-class structure and that the models differed only in the replacement fire frequency, 100yrs in MZ21 versus 130yrs in MZ22. Furthermore, it was noted that during LANDFIRE National model development, the models were the same at one time but were changed because of disagreement among contributors. Blankenship decided to combine the zones based on Sands's recommendation and for consistency with the MZ 21/22 Basin Big Sagebrush model (BpS 10801) because the models and descriptions were very similar and combining models would not change the fire regime group. Blankenship chose the original MZ21 model to represent both MZs 21 and 22 because LANDFIRE leadership review previously indicated that the ca.100yr fire frequency of the MZ21 model better aligned with the literature and expert opinion.
- Sands and a LANDFIRE National reviewer suggested that a 3-class model would appropriately describe this BpS. Sands also suggested that the alternative succession pathway leading to the late closed class was unnecessary. It is presumed he felt that this transition should be accomplished with a deterministic transition as was done in the models for this BpS in the MZ01 group, the MZ06 group, and the MZ10/19 group. Blankenship decided to combine the mid and late open classes based on this suggestion, for consistency with the models for the MZ01 et al., MZ06 et al., and the MZ10/19 groups because the probabilistic transitions for these classes were identical and to improve the s-class mappability.
- Sands and a LANDFIRE National reviewer indicated that the 60% maximum canopy cover value in the late closed class was too high. Both reviewers agreed that cover in this type rarely exceeds 30%. Blankenship reduced the maximum cover to 50%.

MZ28 was added to the MZ21/22 group during the 2017 review of all Big Sagebrush Shrubland models. Sands indicated that the description for MZ28 described a Montane Sagebrush Steppe system and that it should be rewritten or lumped with a similar zone. In MZ28, the dominant shrub species was *Artemisia tridentata* ssp. *vaseyana*, an indicator for Montane Sagebrush Steppe (BpS 11260), not Big Sagebrush Shrubland. Blankenship noted that for the Big Sagebrush Steppe (BpS 11250), MZ28 was grouped with a MZ06 group centered on the Great Basin. For the Big Sagebrush Shrubland, Blankenship decided to group MZ28 with MZ21 because both zones are part of the Western Cordillera ecoregion. MZ22 is part of the Cold Deserts ecoregion. Future review should consider whether this is the most appropriate grouping. The modelers for the MZ28 model were Joe Vinyard, Ken Holsinger, and an anonymous contributor. The MZ28 reviewers were Vic Ecklund and Chuck Kosteka.

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 MZs. 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 MZs 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.

The modelers and reviewers listed in the table at the top of this document were contributors for MZ21. In MZ22, Mark Williams, Vicki Herren, and an anonymous contributor created the model and description, and Tim Kramer, Destin Harrell, and Eve Warren reviewed it.

In the model, native grazing represents the impacts of large ungulates (e.g., bison) and insects.

Succession Classes

Mapping Rules

[illegible]

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 26 Early Development 1 - All Structures

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PSSP6	<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	Upper
ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass	Upper
PASM	<i>Pascopyrum smithii</i>	Western wheatgrass	Upper
HECO26	<i>Hesperostipa comata</i>	Needle and thread	Middle

Description

Herbaceous-dominated, but shrubs (cover <10%) are growing up and do not yet dominate the class. Primarily grasses with forbs. Exact species will vary depending on location. Western wheatgrass, Sandberg bluegrass, Indian ricegrass, needle-and-thread, bluebunch wheatgrass, squirreltail, and blue grama would be dominant grasses. Forbs may include *Astragalus*, *Crepis*, *Castilleja*, *Delphinium*, *Agoseris*, *Phlox*, and others. There may also be a significant component of small green rabbitbrush.

Maximum Tree Size Class

None

Class B 44 Mid Development 1 - Open

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ARTRW8	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	Wyoming big sagebrush	Upper
ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass	Middle
PASM	<i>Pascopyrum smithii</i>	Western wheatgrass	Middle
HECO26	<i>Hesperostipa comata</i>	Needle and thread	Lower

Description

Sagebrush becomes dominant. Understory is well represented by herbaceous species as described for Class A. This class is more common on drier sites. Bottlebrush squirrel tail may also be an indicator.

Maximum Tree Size Class

None

Class C**30****Late Development 1 - Closed**Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ARTRW8	Artemisia tridentata ssp. wyomingensis	Wyoming big sagebrush	Upper
ACHY	Achnatherum hymenoides	Indian ricegrass	Middle
PASM	Pascopyrum smithii	Western wheatgrass	Middle
PSSP6	Pseudoroegneria spicata	Bluebunch wheatgrass	Lower

Description

Dense sagebrush. All primary components of the herbaceous community are present with a significant component of other shrubs. This class is more common on moister sites. Squirreltail could also be an indicator.

Maximum Tree Size Class

None

Model Parameters**Deterministic Transitions**

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:OPN	29
Mid1:OPN	30	Mid1:OPN	999
Late1:CLS	30	Late1:CLS	999

Probabilistic Transitions

Disturbance Type	Disturbance occurs In	Moves vegetation to	Disturbance Probability	Return Interval (yrs)	Reset Age to New Class Start Age After Disturbance?	Years Since Last Disturbance
Native Grazing	Early1:ALL	Early1:ALL	0.001	1000	No	0
Insects or Disease	Early1:ALL	Early1:ALL	0.001	1000	No	0
Wind or Weather or Stress	Early1:ALL	Early1:ALL	0.01	100	No	0
Replacement Fire	Early1:ALL	Early1:ALL	0.0111	90	Yes	0
Native Grazing	Mid1:OPN	Mid1:OPN	0.001	1000	No	0
Insects or Disease	Mid1:OPN	Mid1:OPN	0.001	1000	No	0

Wind or Weather or Stress	Mid1:OPN	Mid1:OPN	0.002	500	No	0
Alternative Succession	Mid1:OPN	Late1:CLS	0.01	100	Yes	0
Replacement Fire	Mid1:OPN	Early1:ALL	0.01	100	Yes	0
Native Grazing	Late1:CLS	Late1:CLS	0.001	1000	No	0
Insects or Disease	Late1:CLS	Late1:CLS	0.001	1000	No	0
Wind or Weather or Stress	Late1:CLS	Mid1:OPN	0.005	200	Yes	0
Replacement Fire	Late1:CLS	Early1:ALL	0.01	100	Yes	0

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