# LANDFIRE Biophysical Setting Model

## *Biophysical Setting* 3111250 Inter-Mountain Basins Big Sagebrush Steppe

☑ *This BPS is lumped with: 1080*

☐ *This BPS is split into multiple models: 1125 describes MZ29 better. 1080 has ARCA13, which doesn't apply in these mapzones. Production is somewhat different, but not enough to split out (Benkobi).*

## *General Information*

**Contributors** (also see the Comments field) **Date** 10/3/2006

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**Vegetation Type**
Upland
Savannah/Shrub
Steppe

**Dominant Species**
ARTRW8
PASM

**Map Zone**
31

**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

BOGR2
CHRYS9
PSSP6
HECO26
NAVI4
CAFI

### Geographic Range

This system encompasses eastern and central MT, as opposed to throughout the Rocky Mountains, etc. as BpS 1125 usually refers to. 1125 is common throughout MZs 20 and 29 currently (not necessarily historically), except in western part of section 331Da. In MZ29, it is common historically.

For MZ29, it would occur in northeast WY section 331G. Thunder basin grasslands. Northeast of 331Gg.

For MZ29, basin big sage is very uncommon. Subspecies vaseyana (BpS 1126) at higher elevations associated with Bighorn, Pryor Mountains and Laramie ranges in sections of M331. Subspecies wyomingensis occurs elsewhere where vaseyana doesn't occur.

In MZ29, occurs in southeast MT. But it could have been soil anomaly. It probably occurred historically all through the subsections of southeast MT. Also through MZ30 in 331Mi in western Dakotas, 331Md in lower portion. As move north in 331Md, less of it. Probably does not occur in 331Mc. Canopy cover of sage is probably <10%.

### Biophysical Site Description

This system is Great Plains Sagebrush Steppe for MZ20. For MZ29, we are describing sagebrush wheatgrass steppe, where western wheatgrass is dominant. MZs 20 and 29 are very similar for this type.

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Soils are primarily dry from sedimentary processes in this system; soils are less fertile in this system, sometimes more calcareous. The Great Plains expression is found exclusively on "heavy" textured soils derived from shale and mudstones and can be strongly correlated with particular geologic formation or members thereof.

April, May and June have by far the most precipitation and this peaks in late May, early June. This pattern carries throughout the MT portion of the Great Plains though a gradient of more summer precipitation as you progress eastward but still the "spring" peak. It's not until you encounter tallgrass prairie does summer precipitation become predominant.

Wyoming big sagebrush occupies plains, foothills, terraces, slopes, plateaus, basin edges and even lower mountain slopes due to the fact that mountain big sagebrush is not part of the mix in MZ20 nor in MZ29. Soils are shallow to moderately deep, moderate to well drained and almost exclusively fine textured soils. Wyoming Big sagebrush generally occurs in the 5-15in precipitation zones. Soil depth and accumulation of snow enhances these communities in lower precipitation zones (Knight 1994).

In MZ29, Wyoming big sagebrush can occur from 2200ft up to 8000ft.

Bluebunch-Wyoming big sagebrush type is probably an inclusion in this BpS occurring on steep, south aspect slopes, typically badlands slopes/topography.

## Vegetation Description

Wyoming big sagebrush is the dominant mid-to late seral species within this plant assemblage.

PASM and ELLA3 are by far the dominant grasses in MZ20 expression of this BpS. In MZ29, PASM, HECO26 and BOGR2 are by far the dominant grasses. Cool season grasses such as Indian ricegrass, bluebunch wheatgrass (Indian ricegrass and bluebunch wheatgrass occur only where coarser textured soils prevail), needle-and-thread (needle-and-thread has a broad ecological amplitude but is more typically abundant on coarse soils; however, under heavy grazing, it does quite well on fine-textured soils), blue grama, Sandberg bluegrass, squirreltail, threadleaf sedge and infrequently Thurber's needlegrass. Rhizomatous wheatgrasses, such as western wheatgrass and thickspike wheatgrass and plains reedgrass, are common species within these MZs 20 and 29. Junegrass also occurs.

Common forbs are species of Astragalus, Crepis, Delphinium Phlox and Castilleja, while associated shrubs and shrub-like species can be small green rabbitbrush, fringe sagewort, winterfat and broom snakeweed. Other dominant species of forbs include RACO3 and SPCO. Also, LIPU and PHHO occurs.

Forbs most important for MZ20 include SPHCOC, DALPUR, PHLHOO, RATCOL and OPUPOL. Other forbs in MZs 10 and 19 include hawksbeard (Crepis acuminata), bird's beak (Cordylanthus spp.), blue bell (Mertensia spp.), Rocky mountain aster (Aster scopulorum), Phlox species, lupine (Lupinus spp.) and buckwheat (Eriogonum spp.). In MZ29, all of the above are probably found except for lupine, which would occur in higher precipitation areas and associated with mountain big sagebrush.

Herbaceous species usually dominate the site prior to re-establishment. Site re-establishment is by seed bank, seed production from remnant plants and seeds from adjacent (untreated) plants.

Wyoming big sagebrush in upland sites have fewer understory species relative to the mountain big sagebrush subspecies, though at higher elevations or moister areas of this vegetation community there is a

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higher potential for herbaceous species, relative to basin big sagebrush sites; no definitive statement on undergrowth herbaceous diversity can be made for Wyoming big sagebrush sites. Herbaceous cover increases transitioning into the mixed-grass prairie and in open patches.

Basin big sagebrush is not found in MZ29. Wyoming big sagebrush is found where mountain big sagebrush not present. It can occur with greasewood and silver sagebrush, as well as rabbitbrushes and saltbush.

## 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 (Wyoming Interagency Vegetation Community 2002). Drought may have been more significant disturbance than native grazing or insects, so was included. Native grazing by large ungulates (e.g., bison), and insects were included as occurring every 10yrs but causing no transitions to another class. Heavy-impact grazing in the late closed stage occurs less frequently and causes a transition to an open state.

Following fire or other significant disturbance, herbaceous species will dominate the ecological site post-burning and recovery to pre-fire canopy cover is quite variable and may generally take 50-120yrs, but occasionally occurs within a decade (Baker, in press). Site re-establishment is by seed production from remnant plants, and seeds from adjacent (untreated) plants. Discontinuity of fuels 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, in press). Fire does not stimulate germination of soil-stored Wyoming big sagebrush, but neither does it inhibit its germination (Chaplin and Winward 1982). Regeneration may occur in pulses linked to high precipitation events (Maier et al. 2001).

Overall fire return intervals in Wyoming big sagebrush appear to have ranged from 100-240yrs or more (Baker, in press) for MZ22. In MZ20, some believe that intervals are shorter, with replacement fire occurring approximately every 30yrs in some of the classes (based on BLM Fire Management plans and local expert estimate, Downey). However, there was disagreement with that short interval. It is also said that we are fairly certain of the recovery time required (50-150yrs, mostly around 100yrs), and with this slow recovery, if fires returned to the site in 30yrs, eventually the whole landscape would be only Class A and maybe B (open) (Cooper, personal correspondence). Therefore, for MZ20, MFRI was modeled at an overall 90yr interval, similar to other adjacent mapzones and similar to BpS 1080 MFRI of 80yrs, which this BpS is thought to be very similar to.

There was some disagreement among MZ20 modelers as to the MFRI of 90 for this 1125 system. Up north, where there is a heavy grass component and much less % cover of sage than what is down south, and relatively connected topography and a lot of wind, it would burn more frequently (Downey, pers comm). Perhaps that would be considered BpS 1085 instead of BpS 1125. And even though BpS 1085, which is also comprised mainly of WY Big sage has an MFRI of 30yrs, these 2 systems are different as it relates in large part to setting and precipitation patterns, and continuity of fuels. Eastern MT has few breaks, unlike mountain systems, and would be much more likely to have huge sweeping fires. Although the species are the same, Wyoming big sagebrush, the systems aren't (Martin, pers comm). The longer MFRI for 1125 was therefore retained.

Benkobi (pers comm) states that in MZ29, fire frequency could range from 36-40yrs (http:/gisdata.usgs.net). However, MZ29 reviewers did not want to change the model. However, because it

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was also stated that recovery occurred after at least 60yrs in MZ29, and due to the discrepancy from previous mapzones, the MFRI from MZ20 was retained.

Discontinuity of fuel in Wyoming big sagebrush communities often result in mosaic burn patterns, but large expanses can burn with complete mortality under extreme conditions (Bushey 1987, Baker, in press). Mixed severity fire was originally modeled in this BpS but due to a new understanding of definitions of severity types, it was thought that mixed severity fire does not occur in this system and rather patchy fires do occur, with replacement severity.

There have been prescribed burns in MZs 20 and 29. After 29yrs, there is still zero recovery of Wyoming big sage (Cooper pers comm). It is thought that the Wyoming big sagebrush communities take longer than 100yrs to recover. In Bighorn battlefield, historically there was a lot of sagebrush. It was burned in mid-80s and there is still no evidence of sagebrush re-establishment 10yrs later.

Antelope, mule deer and pygmy rabbits (probably not MZ29) are native herbivores that browse sagebrush. These were also not included in the model. Sage grouse might also have an impact? It is questionable as to the impact/frequency of antelope and mule deer in MZ29.

### Adjacency or Identification Concerns

This type is difficult to distinguish from mixed-grass prairie with a high shrub component. It is possible that with severe disturbance, a state change might occur to mixed-grass prairie - which in turn changes the potential for the site to return to sagebrush. Extensive severe burns for want of an adjacent seedbank would take extensive periods before Wyoming big sagebrush was again a significant component. The reference condition might have been sagebrush, but now the abiotic factors and biophysical gradients indicate a mixed-grass prairie.

Secondary shrub and herbaceous components may vary considerably across the range of its extent. Wyoming big sagebrush sites may be a mosaic with or abut Juniper, ponderosa pine, salt desert shrub and grassland vegetation types across its range. However, the most common accompanying vegetation is NGP midgrass prairie.

Broom snakeweed and Halogeton may dominate sites disturbed by overgrazing, oil and gas development, or other disturbances. Club moss in this system increases with the intensity and duration of grazing. BROJAP can be an increaser with burning/grazing. There is also BROTEC invasion but that doesn't occur in the Northern Great Plains, except in MZ29.

Juniper increase might be occurring due to lack of fire today, but it is not developing into a true juniper woodland, especially in MZ29.

Shrub cover increases in MZs 20 and 29 with overgrazing and the herbaceous layer decreases dramatically.

Might be difficult to distinguish from BpS 1080 and BpS 1085.

Much of 1080 has been lost due to land clearing for agriculture or converted to a cheatgrass or greasewood type. For basin big sagebrush in MZ29, this is the case. For Wyoming big sagebrush in MZ29, much has been lost due to burning for modern grazing. The understory is currently more annual bromes due to increased grazing.

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Overgrazing has also been an issue in 1080. HESCOM and KOEMAC increase (MZ20) where grazing is intense and protracted. It is questionable as to whether HESCOM increases with grazing (some areas of MZ29), and might rather decrease with overgrazing. With overgrazing in some areas of MZ29, more bluegrasses.

Plant associations are similar between 1125 and 1080. Shrubland is perhaps further south. Herbaceous cover is the only distinguishing factor. 1125 is definitely the more prominent historically. 1080 more prevalent in central WY. These (like mixegrass prairie) are distinguished by geography. Therefore, they are being combined for MZ29.

In Bighorns battlefield (around Hardin, MT), historic photos showed dense (up to 20%-30% cover) shrub covered system, but currently, mostly grass - due to fires that burned there (Clark et al 1995 DRAFT).

If adjacent to pine systems, might be seeing more trees currently. (also in grass systems). This was seen in historic photographs throughout MZ29 in northern part and through western SD (Clark et al 1995 DRAFT).

### Native Uncharacteristic Conditions

Over 45% shrub cover would be uncharacteristic for MZ20 and MZ29. In fact, Wyoming big sagebrush in MZ29 would not exceed 40% cover. The only reason it would be this high is in cases of extreme overgrazing or in the absence of fire or changes in fire regime - frequency.

### Scale Description

Occurrences may cover between hundreds and thousands of hectares.

Disturbance patch sizes range from 10s-1000s of hectares. The patch and disturbance size gets larger as this shrub BpS intergrades with the grassland BpS, and also gets larger from MZs 19 and 20 into MZ29.

### Issues/Problems

Difficult to identify where hybrids occur with other big sagebrush taxa.

### Comments

This model for MZ29 was adapted from the same BpS from MZ20 created by Steve Cooper and Shannon Downey and reviewed by Steve Barrett. For MZs 29 and 30, descriptive additions and changes were made. Other reviewers for MZ29 were Bobby Baker and Jim Von Loh.

Model for MZ20 was adapted from the draft model for MZ22 for 1125b Inter-Mountain Basins Big Sagebrush Steppe-Wyoming Big Sagebrush, created by Mark Williams, Vicki Herren and an anonymous contributor and reviewed by Tim Kramer, Eve Warren and Destin Harrell. Changes were made to the description and model.

The model for MZ22 was adapted from Rapid Assessment (RA) model R0SBWYwy created by Tim Kramer (tim_kramer@blm.gov) and reviewed by Bill Baker, Don Bedunah and Dennis Knight.

For the Rapid Assessment, the workshop code was WYSB. This model was combined with another Rapid Assessment model, R0SBWA (workshop code was WSAG1), modeled by George Soehn (george_soehn@blm.gov) and reviewed by Sarah Heide (sarah_heide@blm.gov) and Krista Gollinick-

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Waid (krista_waid@blm.gov). The two were combined based on peer-review and the similarity of disturbance regimes and species composition.

The RA Model is based on the original FRCC PNVG (WYSB1) with modifications from Wyoming Interagency Vegetation Committee (2002) and expert estimates. Peer review for the RA model was incorporated 4/30/2005. Additional reviewers were Karen Clause (karen.clause@wy.usda.gov), Ken Stinson (ken_stinson@blm.gov) and Eve Warren (eve_warren@blm.gov).

## Vegetation Classes

### Class A 35 %

Early Development 1 All Structure

**Upper Layer Lifeform**

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

**Fuel Model**

2

**Indicator Species and Canopy Position**

NAVI4
Upper
PASM
Upper
BOGR2
Lower
CAFI
Lower

**Structure Data (for upper layer lifeform)**

| | Min | Max |
|---|---|---|
| *Cover* | 0 % | 80 % |
| *Height* | Herb 0m | Herb 0.5m |
| *Tree Size Class* | | |

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

Herbs dominate this class, but shrubs are growing up and do not yet dominate the class. Shrub cover less than five percent belongs in this class.

**Description**

Herbaceous dominated. In the presettlement condition, NAVI4 (in MZ20) and HECO26 in MZ29 would have been a major upper position component. Primarily grasses with forbs. Exact species will vary depending on location. Western wheatgrass, Sandberg bluegrass, plains reedgrass, needle and thread, bluebunch wheatgrass, threadleaf sedge, plains junegrass, and blue grama would be dominant grasses. Forbs may include Astragalus, Crepis, Castelleja, Delphinium, Agoseris, Phlox and others. There may also be significant component of small green rabbitbrush.

Succession to class B, a mid-development open stage, occurs after 40yrs. This succession was originally modeled at 20yrs; however, it was later decided that that was a minimum age for succession, and it would take more like 40yrs to achieve 5-15% canopy cover of ARTTSW. There is one paper that shows no ARTRW8 15yrs post-fire and another paper for MZ19 that indicates no recovery after as much as 18yrs (Cooper, personal correspondence). In MZ29, recovery occurred after 60yrs.

Insect/disease (0.001 probability or .1% of the landscape each year), native grazing (.1 probability or 10% of the landscape each year), and wind/weather stress ( every 100yrs, 0.01 probability or 1% of the landscape each year) occur, but do not cause a transition.

Replacement fire was originally modeled at every 30yrs, based on expert estimate and local observations. - in BLM Fire Management Plans (Downey, personal correspondence). However, this was later changed to 90yrs based on recovery times of this type. This, and the other changes in age range, changed the class %age from 20 to 35%.

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### *Class B* 40 %

Mid Development 1 Open

**Upper Layer Lifeform**

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

**Fuel Model**

2

**Indicator Species and Canopy Position**

ARTRW8
Upper
PASM
Mid-Upper
NAVI4
Mid-Upper
HECO26
Middle

**Structure Data (for upper layer lifeform)**

| | Min | Max |
|---|---|---|
| *Cover* | 0 % | 20 % |
| *Height* | Shrub 0m | Shrub 0.5m |
| *Tree Size Class* | | |

☐ Upper layer lifeform differs from dominant lifeform.

**Description**

Sagebrush canopy is >5% but <15%. Understory is well represented by herbaceous species as described for class A. (Montana Academy of Sciences publication - re: in breaks, After 15yrs after fire, no sage yet.)

ARFR4 also present in lower canopy.

Succession to class C, late development closed stage, occurs after 50yrs. (60yrs for MZ29)

Insect/disease (0.001 probability of 0.1% of the landscape each year), native grazing (0.1 probability or 10% of the landscape each year), and wind/weather stress (every 100yrs, 0.01 probability or one percent of the landscape each year) occur, but do not cause a transition to another stage.

Fire was modeled more frequently than in MZ22 based on expert estimate and data from BLM Fire Mangement Plans. Originally, mixed fire was modeled at occurring every 40yrs, maintaining the class in this stage (Downey, personal correspondence). However, this was later removed due to a new understanding of definitions of mixed versus replacement fire. This, and the other changes in age range, changed the class percentage from 55% to 35%. Replacement fire occurs every 90yrs.

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### *Class C* 25 %

Late Development 1 Open

**Upper Layer Lifeform**

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

**Fuel Model**

2

**Indicator Species and Canopy Position**

ARTRW8
Upper
PASM
Mid-Upper
NAVI4
Mid-Upper
HECO26
Middle

**Structure Data (for upper layer lifeform)**

| | Min | Max |
|---|---|---|
| *Cover* | 21 % | 40 % |
| *Height* | Shrub 0m | Shrub 0.5m |
| *Tree Size Class* | | |

☐ Upper layer lifeform differs from dominant lifeform.

**Description**

Sagebrush canopy is >15%. Understory is well represented by herbaceous species as described for class A. This class is more common on drier sites.

Shrub cover max was 30% in MZ20. In MZ29, it was increased to 65% cover by other reviewers. However, it was decided that here could not be this amount of cover. Modal cover is 15%. The most measured was 32% cover. Some could have been higher cover but not much. Common in literature that grazing/over-grazing increases cover, not the opposite. It is probably more common in 20% range. 40% is high, but could be a max (Cooper, diBenedetto, personal comm). Regional lead changed to 40% per comments.

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ARFR4 is also present in lower canopy.

Insect/disease (0.001 probability of 0.1% of the landscape each year), native grazing (0.002 probability or 0.2% of the landscape each year) cause a transition to the mid-open stage.

Native grazing (0.1 probability or 10% of the landscape each year) occurs, but does not cause a transition to another stage.

Drought was modeled at an overall interval of 100yrs split between maintaining this stage or taking it to the mid-development stage.

Originally, mixed fire was modeled at occurring every 40yrs, maintaining the class in this stage (Downey, personal correspondence). However, this was later removed due to a new understanding of definitions of mixed versus replacement fire. Replacement fire occurs every 100yrs. This only changed the class percentage from 25% to 30%.

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***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**

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***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*

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**Fire Regime Group**:** IV

**Historical Fire Size (acres)**

Avg
Min
Max

**Sources of Fire Regime Data**

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

| Fire Intervals | Avg FI | Min FI | Max FI | Probability | Percent of All Fires |
|---|---|---|---|---|---|
| *Replacement* | 90 | | | 0.01111 | 100 |
| *Mixed* | | | | | |
| *Surface* | | | | | |
| *All Fires* | 90 | | | 0.01113 | |

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

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