LANDFIRE Biophysical Setting Model

Biophysical Setting 2110802 Inter-Mountain Basins Big Sagebrush Shrubland - Wyoming Big Sagebrush

☐ *This BPS is lumped with:*

☑ *This BPS is split into multiple models:* *Different from basin big sagebrush in fire regimes, floral composition and occurrence in drier uplands. See 10801 for split reasons also.*

Basin big sagebrush is found at lower elevations and is usually restricted to comparatively moist ravines or valleys (Barker and mcKell 1986 in Knight 1994). It also grows taller than any other species of Artemisia (up to two meters or more.). Wyoming big sagebrush is the most common shrub of the intermountain basins. It is normally less than 0.5 m tall and occupies the drier uplands, with the taller basin big sagebrush occurring in adjacent ravines (Knight 1994). Basin big sagebrush more common on sandy soils, and Wyoming big sagebrush more common on fine-textured soils (Knight 1994).

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).

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. Basin big sagebrush tends to occupy the deepest, most fertile soils (FEIS).

General Information

Contributors (also see the Comments field) **Date** 7/12/2006

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Vegetation Type
Upland
Savannah/Shrub
Steppe

Dominant Species
ARTRW8
PSSP6

Map Zone
21

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

POSE
CHRYS9
STAC
PHHO
FEID

**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.

Geographic Range

Wide-ranging, common to Basin and Range province, extending into the Columbia Plateau and east into the northern and central Rockies and the western edge of the short grass prairie. Common throughout MZ22.

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 generally occurs in the 5-14in precipitation zones. Soil depth and accumulation of snow enhances these communities in lower precipitation zones (Knight 1994).

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). In WY, a considerable amount of Wyoming big sagebrush occurs in the 5-9in and the 10-14in precipitation zones.

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).

WY: 5000-7000ft (1500-2100m)

Vegetation Description

Wyoming big sagebrush is the dominant mid to late-seral species within this plant assemblage. Cool season grasses such as Indian ricegrass, bluebunch wheatgrass, needle-and-thread, blue grama, Sandberg bluegrass, squirreltail and infrequently Thurber's needlegrass are common. Rhizomatous wheatgrasses, such as western wheatgrass, are common species within this map zone. Common forbs are species of Astragalus, Crepis, Delphinium and Phlox and Castilleja, while associated shrubs and shrub-like species can be small green rabbitbrush, black sagebrush, spiny hopsage, winterfat and broome snakeweed. 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. Cryptobiotic organisms (VAM) are important.

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 the MZ22, in subsections 342 Fj, 342Fl, 342Fi, 342Ff and 331Gb, herbaceous cover increases transitioning into the short-grass prairie.

In MZ21, in western MT, Artemisia tridentata is in the habitat types of ARTR/AGSP, ARTR/FESC and ARTR/FEID.

In MT, Ericameria nauseosa (=Chrysothamnus nauseosus) and Artemisia frigida are consistently present in amounts less than five percent, unless the community has experienced abusive grazing. Elymus lanceolatus is conventionally the dominant and diagnostic graminoid, though in exceptionally mesic representations it may have less cover than Nassella viridula or Poa pratensis. Other important associated graminoids include Koeleria macrantha, Hesperostipa comata (=Stipa comata), Bouteloua gracilis and Carex filifolia. Total forb cover is low while the more constant species are Sphaeralcea coccinea, Vicia americana, Achillea millifolium and Opuntia polyacantha.
(http://www.mtnhp.org/Community/guide_report.asp?elcode=CEGL001044)

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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 at 500yr intervals.

Native grazing by large ungulates (eg, bison), and insects were included, but at 1000yr intervals.

Following fire or other significant disturbance, herbaceous species will dominate the ecological site post-burning and recovery to prefire 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 bank, seed production from remnant plants and seeds from adjacent (untreated) plants. Discontinuity of fuel in Wyoming big sagebrush communities can result in mosaic burn patterns, leaving remnant plants for seed, but there 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 could have ranged from 100-240yrs or more (Baker in press), and some feel that they appear to have ranged from 10-110yrs or more, and recovery to 20% canopy cover from a burn may take more than 40yrs (Young and Evans 1981, Winward 1991). Bunting et al. (1987) found that the average recovery time following fire in Wyoming big sagebrush communities was 30yrs. Others have cited intervals of Wyoming big sagebrush at between 50-100yrs (Miller and Eddleman 2004; Miller et al. 1994; Wright and Biley 1982; Whisenant 1990; Miller and Tausch 2001) and up to 110yrs (West 1999; Whisenant 1990). It is unclear as to whether or not these studies considered recovery rate or the limitations of fire history studies.

Reviewers for MZ22 felt that 130-year interval was justified, as Wyoming big sagebrush does not re-establish for multiple decades, and fire was therefore likely infrequent (Warren, pers comm).

Reviewers for Rapid Assessment disagreed about the frequency of fire and severity of fire, suggesting MFIs of 90-140yrs and no mixed severity fire to 50% mixed severity fire. The majority of reviewers agreed with the original model, however, so the quantitative model was unchanged. Descriptive information was added to capture the disparate opinions of reviewers.

Fire scars provide little information on low elevation sage when there are no forests nearby; fire scar estimates are therefore low estimates of fire rotation as they come from locations that would have had more fire than is typical of sagebrush (anonymous contributor, personal correspondence).

We have no means to accurately measure historic fire frequency in sagebrush communities (Kitchen, personal correspondence), and there are conflicting opinions as to the approaches taken to determine MFI 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 MFI for Wyoming big sagebrush steppe (productive) is between 60-120yrs and 75-200yrs for Wyoming big sagebrush shrubland (Kitchen, personal correspondence). We really don't know how fire might have behaved across the fuel threshold at the

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forest/shrubland ecotone. Therefore, we don't know how accurately proxy fire chronologies derived from fire-scarred trees predict fire regimes in nearby shrublands (Kitchen, personal correspondence).

As per FEIS (Howard 1999) - Wyoming big sagebrush steppe communities historically had low fuel loadings and were characterized by 10-70yr interval, patchy fires that produced a mosaic of burned and unburned lands. Fire scars on western juniper in a Wyoming big sagebrush/bluebunch wheatgrass community in Lassen County, CA, showed fire return intervals ranging from 10-40yrs. Vincent suggests that in northern NM, infrequent fire probably maintained Wyoming big sagebrush communities as open, seral stands of Wyoming big sagebrush with productive herbaceous understories. Historic mean fire return interval in northern NM of Wyoming big sagebrush communities is estimated at 40-50yrs

After an extensive model review process, LANDFIRE leadership/guidance determined that the original modelers for MZ22 used an interpretation of the fire information available on sagebrush systems that did not represent the majority expert opinion/interpretation of the fire literature to be used for MZ21. The MZ21 model was therefore altered to reflect majority opinion/interpretation of literature regarding the fire regime of this sagebrush system. For MZ21, an interval of 100yrs was chosen. This interval is still considered on the longer side of the range by some (A Winward, pers comm). This interval was similar to that used in MZs 18, 23, 10, 19 (if mixed fire removed) and 20 and R0SBWYwy. This is also in line with Kitchen's estimate of 60-120yrs in Wyoming big sagebrush productive steppe and 75-200yrs in Wyoming big sagebrush shrub. It is somewhat higher (less frequent fire) than FEIS's estimate. Also, because this interval must be longer than that for mountain big sage (50yrs) and basin big sagebrush(70yrs), 100yrs seemed to be an appropriate value.

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 non-hybridized 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 abut 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 map zone. In some cases apparent invasions are simply recovery from past fires or temporary fluctuations along ecotones (Pers. Comm., Mark Williams, anonymous contributor).

Native Uncharacteristic Conditions

Greater than 60% canopy cover of Wyoming big sagebrush. In drier sites, canopy cover may not exceed >50%.

Scale Description

Occurrences may cover thousands of hectares.

Issues/Problems

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

Comments

This model for MZ21 was adopted from the draft model from MZ22 BpS 10802 created by Mark Williams (mark_a_williams@blm.gov), Vicki Herren (vicki_herren@blm.gov) and an anonymous contributor and reviewed by Tim Kramer (tim_kramer@blm.gov), Destin Harrell (destin_harrell@blm.gov) and Eve Warren (eve_warren@blm.gov). Some modifications in descriptions were made. After an extensive model review process, LANDFIRE leadership/guidance determined that the original modelers for MZ22 used an interpretation of the fire information available on sagebrush systems that did not represent the majority expert opinion/interpretation of the fire literature to be used for MZ21. The MZ21 model was therefore altered to reflect majority opinion/interpretation of literature regarding the fire regime of this sagebrush system.

This 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.

Workshop code for Rapid Assessment (RA) was WYSB. This model was combined with another RA 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-Waid (krista_waid@blm.gov). The two were combined based on peer-review and the similarity of disturbance regimes and species composition.

Model is based on the original FRCC PNVG (WYSB1) with modifications from Wyoming Interagency Vegetation Committee (2002) and expert estimates.

Peer review 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). Reviewers disagreed about the frequency of fire and severity of fire. Descriptive information was added to capture the disparate opinions of reviewers.

Vegetation Classes

Class A **25 %**

Early Development 1 All Structure

Upper Layer Lifeform

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

Fuel Model

2

Indicator Species and Canopy Position

PSSP6 Upper
ACHY Upper
PASM Upper
HECO26 Middle

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0 %	60 %
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. 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, Castelleja, Delphinium, Agoseris, Phlox and others. There may also be significant component of small green rabbitbrush.

**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.

This class succeeds to mid-development open stage after 30yrs.

Insect/disease and grazing occur with a probability of 0.001. Wind/weather stress occurs every 100yrs.

Replacement fire occurs every 90yrs.

Class B **20 %**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

2

Indicator Species and Canopy Position

ARTRW8
Upper
ACHY
Middle
PASM
Middle
HECO26
Lower

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	11 %	30 %
Height	Shrub 0m	Shrub 0.5m
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

Sagebrush canopy is greater than five percent but <25%. Understory is well represented by herbaceous species as described for class A. Bottlebrush squirrel tail may also be an indicator.

This class succeeds to an open stage with taller shrubs in 40yrs, although it can succeed to a closed stage with taller shrubs with a probability of 0.01.

Insect/disease and grazing occur with a probability of 0.001 and wind/weather stress occurs every 500yrs, but do not cause a transition.

Replacement fire occurs every 100yrs.

Class C **25 %**

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

2

Indicator Species and Canopy Position

ARTRW8
Upper
ACHY
Middle
PASM
Middle
HECO26
Lower

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	11 %	30 %
Height	Shrub 0.6m	Shrub 1.0m
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

Sagebrush canopy is greater than five percent but <25%, occasionally reaching 30%. 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.

This class persists, although it could succeed to a closed stage with a 0.01 probability. Note: ages for this class in the model start at age 30, just so that the disturbance/alternate succession doesn't necessarily advance age. However, this class truly starts at age 70 and persists. This does not make a difference in the model output but rather just conforms to modeling rules.

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Insect/disease and grazing occur with a probability of 0.001 and wind/weather stress occurs every 500yrs, but do not cause a transition.

Replacement fire occurs every 100yrs.

Outside reviewer for MZ21 commented, after models delivered, that classes B and C might be better represented if combined together into one class.

Class D **30 %**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

2

Indicator Species and Canopy Position

ARTRW8
Upper
ACHY
Middle
PASM
Middle
PSSP6
Lower

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	31 %	60 %
Height	Shrub 0.6m	Shrub 1.0m
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

Sagebrush canopy is >25%. All primary components of the herbaceous community are present with significant component of other shrubs. This class is more common on moister sites. Squirreltail could also be an indicator.

This class will persist. Note: ages for this class in the model start at age 30, just so that the disturbance/alternate succession doesn't necessarily advance age. However, this class truly starts at age 70 and persists. This does not make a difference in the model output but rather just conforms to modeling rules.

Insect/disease and grazing occur with a probability of 0.001, but do not cause a transition. Wind/weather stress occurs every 200yrs and causes a transition to an open stage.

Replacement fire occurs every 100yrs.

Outside reviewer for MZ21 commented after model already delivered, that over 30% cover is a lot of cover for this type in this mapzone, and that 60% cover would be unheard of. And if this class D is 30-60% cover, there should be less than 10% of class D in reference conditions and not 30%.

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

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Disturbances

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	100	30	240	0.01	100
Mixed					
Surface					
All Fires	100			0.01002	

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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