LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010110 Rocky Mountain Aspen Forest and Woodland

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

General Information

Contributors (also see the Comments field) **Date** 6/16/2006

Modeler 1 Steve Barrett sbarrett@mtdig.net **Reviewer**
Modeler 2 **Reviewer**
Modeler 3 **Reviewer**

Vegetation Type
Forest and Woodland

Map Zone
20

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

Dominant Species*
POTR5 PIEN
PSME GRASS
PICO
ARTR2

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
This ecological system is widely distributed in MZs 21 and 20 within a mosaic of other communities in the northern US Rockies. But in MZ20, this BpS is very limited in abundance. Communities are usually small in spatial extent, generally <25ac (10ha) in size in the northern portions of this zone, in contrast to larger communities in the central and southern Rockies. Subsections M331Dd, M331Dm, 342Dg, M331Db and 342Dd have communities in patches ranging from 25-100ac (10-40ha) in size.

Biophysical Site Description
Most aspen in MZ21 occurs at elevations from 1525-2285m (5000-7500ft) in the northern portion of the zone and up to 8500ft or 2590m in the southern portion of the zone. Aspen typically occurs in the ecotone between grasslands/shrublands and the coniferous forest (montane/subalpine), usually in close association with Douglas-fir forest as well as other conifer forests. Aspen is occasionally found at lower and higher elevations, but these stands are often isolated and small. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand, and secondarily limited by the length of the growing season or low temperatures. In the long term absence of fire, these sites may transition to Douglas-fir or spruce, so there is likely some overlapping with those BpS's.

Vegetation Description
These are upland forests dominated by Populus tremuloides both with and without a significant conifer component (less than five percent to over 40% relative conifer tree cover). Conifer species include Douglas-fir, lodgepole pine, subalpine fir, limber pine and Engelmann spruce. The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs.

Common shrubs include Amelanchier alnifolia, Artemisia tridentata, Prunus virginiana, Rosa woodsii, Shepherdia canadensis, Potentilla gracilis, Symphoricarpos albus and Vaccinium spp.

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Native grasses could include Calamagrostis canadensis, Calamoagrostis rubescens, Carex geyeri, Carex rossii, Elymus glaucus, Elymus trachycaulus and Hesperostipa comata.

Associated forbs may include Taraxacum officinale, Achillea millefolium, Aster conspicuus, Delphinium spp, Geranium viscosissimum, Solidago missouriensis, Senecio triangularis, Lupinus spp, Osmorhiza berteroi (=Osmorhiza chilensis), Rudbeckia occidentalis, Thalictrum occidentalie, Valeriana occidentalis and many others.

Disturbance Description

Replacement fire and patchy replacement fires were historically moderately frequent and helped maintain this ecological system on the landscape. Replacement fire was modeled with an overall MFI of 100yrs. Frequency and size-class fire distributions are not readily available, but fire sizes may be highly variable given the widely ranging vegetation composition and topography.

The clonal aspen root system can persist through long periods of disturbance-free conditions. This root system is also able to rapidly respond by sprouting or root suckering after disturbances. Fires may have been more frequent (eg, <25yrs) where aspen was adjacent or closely associated with grassland or shrubland communities. They occurred approximately every 40yrs in the montane aspen-conifer mix. When adjacent to subalpine zone lodgepole pine or closed-canopy Douglas-fir, fires occurred least frequently, at approximately 100-300yrs (Bradley 1992, Barrett 2004), which could maintain most seral aspen stands. The 100-110yr estimate was a consensus of the reviewers and modelers based on their experience in modern landscapes and literature review (Barrett 2004).

For MZ21, fire was modeled in the replacement regime due to aspen's high fire susceptibility; fire was considered as an “either/or” event resulting in canopy mortality rather than mixed or stand-replacing in severity. Modelers also disregarded the argument of whether aspen is seral or climax and recognized that late successional aspen stages could be mixed with conifers in the absence of fire. Moreover, they included native ungulate browsing as a disturbance regime that could influence successional pathways.

After initial review of MZ21, another reviewer of MZ21 commented that there should be mixed and low-severity fires in this system, and that conifer encroachment should be considered and modeled separately (Tart, personal correspondence). However, this was not modeled in MZ21 as original modelers were unable to respond. In MZ20, however mixed severity fire was considered a component of this BpS (20%).

This BpS can display varying fire severities (FRG II, III and IV) depending on tree species composition, but models are for sites heavily dominated by aspen (FRG IV). Fire Return Intervals in aspen are heavily influenced by adjacent community disturbance dynamics and could vary dramatically spatially on a landscape and through time as conditions change (20-150yrs between disturbances).

Under presettlement conditions, disease and insect mortality probably influenced the stand structure (degree of canopy closure, age classes, etc.) of aspen woodlands in this zone. We assumed that outbreaks would thin older trees >40yrs. Disturbance effects would also have varied from clone to clone. Many aspen clones situated on steep slopes are prone to disturbance caused by avalanches and mud/rock slides. Riparian aspen is prone to flooding and beaver clear-cutting.

Adjacency or Identification Concerns

In this zone, aspen stands tend to be dynamic in size and distribution and interact with adjacent communities. Because patch sizes tend to be small, and because one state in the disturbance model can

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include aspen in the understory of a predominantly coniferous stand, they may be difficult to map and identify.

Aspen decline varies across the region. Factors affecting aspen currently include drought, fire suppression and ungulate browsing. These factors have reduced aspen patch sizes and composition, and/or created senescent stands lacking suckers for regeneration of tree-sized aspen.

In long term absence of fire, these sites may transition to Douglas-fir or spruce; there is likely some overlapping with those BpS's.

Depending on ungulate influence, herbaceous layers may be lush and diverse or depauperate and dominated by exotic grasses. Common exotic graminoids may include Bromus inermis, Poa pratensis and Phleum pratense.

Herbivory also affects the growth rates of aspen sprouts or suckers and, at high levels, has the potential to overwhelm the sprouting or suckering response and prevent overstory recruitment from occurring.

Native Uncharacteristic Conditions

Scale Description

Patch size for this type ranges from less than one ha to 10ha; occasionally, aspen occurs in patches larger than 10ha in the northern portion of the zone. In the southern portion of the zone, patches from 10-40ha are more common in low elevation. Patches may be linear along riparian areas and the forest/grassland ecotone. Nonlinear patches are often localized in swales, depressions and toeslopes.

Communities are usually small in spatial extent, generally <10ha in size in the northern portions of this zone, in contrast to larger communities in the central and southern Rockies. Subsections M331Dd, M331Dm, 342Dg, M331Db and 342Dd have communities in patches ranging from 25-100ac (10-40 ha) in size.

Issues/Problems

Aspen dynamics over the past several centuries are difficult to characterize due to relatively short lifespan, rapid decay of tree ring records and the lack of clear patterns of broad-scale establishment of tree-sized stands as occurred in the late 1800s. Range of variation in the recruitment of tree-sized stems may be substantially wider than currently considered. Disturbance regimes, particularly with regard to measures of central tendency surrounding fire size, appear highly variable, and are dependent on information obtained from different but adjacent vegetation types. Nonetheless, the ecological importance of aspen may still justify management for vigorous tree-sized aspen stands.
This BpS can be rare in some portions of MZ21, although ecologically significant, and likely difficult to map in areas of high conifer encroachment. In the southern portion of MZ21, aspen is not rare, but occurs at low levels and was much more prevalent on the landscape historically.

Comments

This model for MZ20 was adapted from the same BpS in MZ21, which was created by Roy Renkin, Nathan Korb and Jodie Canfield and reviewed by Liz Davy, Tim Belton, Dave Barron, Spencer Johnston, Candi Eighme, Lisa Heiser and Heidi Whitlatch. For MZ20, descriptive changes and minor quantitative changes were made to better represent the composition within the MZ20 area.

The model for MZ21 is based on the model from MZs 12,17,10 and 19. Models in MZs 12 and 17 were

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created by Louis Provencher and Julia Richardson. Models in MZs 10 and 19 were created by Krista Waid-Gollnick and Sarah Heide.

BpS 1011 for MZs 17 and 12 is intended to represent stable aspen as found on many ranges of NV. BpS 1011 for MZs 12 and 17 is different from BpS 1011 for MZ16. BpS 1011 for MZ16 was modeled by Linda Chappell, Robert Campbell, Stanley Kitchen (skitchen@fs.fed.us), Beth Corbin (ecorbin@fs.fed.us) and Charles Kay. R2ASPN was modeled by Linda Chappell (lchappell@fs.fed.us), Robert Campbell (rbcampbell@fs.fed.us) and Bill Dragt (William_Dragt@nv.blm.gov). R2ASPN was reviewed by Cheri Howell (chowell02@fs.fed.us), Wayne Shepperd (wshepperd@fs.fed.us) and Charles Kay (ckay@hass.usu.edu).

Vegetation Classes

Class A 15%

Indicator Species* and Canopy Position

Early Development 1 All Structures POTR5 Upper

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Tree 0m	Tree 5m
Tree Size Class	Seedling <4.5ft	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Aspen suckers less than two meters tall. Understory species include a wide variety of shrubs, forbs and grasses. Under moderate to intense browsing, this condition could persist for long periods. Under light browse intensities, succession to class B after 15 yrs. (For MZ21, this class ended at 10yrs; however, for MZ20, it was changed to 15yrs in order to accommodate for more class A on the historical landscape - 15% vs 10%.)

This structure is an established, persistent, shrub-type aspen clone that is maintained in this state either because of continual browsing or suboptimal site conditions. As such, it was the starting point in which to model asexual regeneration in the face of disturbance. A reviewer suggested that this class would be eliminated and returned to grass in three years under intense browsing; however, that scenario is not an accurate depiction of this class. This condition does not represent site establishment via sexual reproduction that would revert to grass three years after seedling establishment. Also, although aspen suppression by herbivores is important in the Greater Yellowstone Ecosystem (which would more likely be a current condition, not the reference condition scenario being described), there seems to be insufficient evidence that this process can extirpate a patch in three years. Aspen appears relatively persisting and although it certainly can be extirpated, it is believed that this occurs far less frequently.

Native grazing occurs with a probability of 0.04, which returns the class to the beginning of the state.

Class B 20%

Indicator Species* and Canopy Position

Mid Development 1 All Structures POTR5 Upper

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

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Aspen 2-10m tall dominate. Canopy cover usually closed representing dense sapling stand. Fire frequency is highly variable because of site conditions and adjacent vegetation. Replacement fire was originally modeled at every 60yrs but was changed to a 100yr frequency based on review.

Insect/disease outbreaks are rare and were not modeled to result in successional pathway changes. Because herbivory was insufficient to prevent succession, it was not modeled. Class B therefore represents a transitional stage toward a mature aspen stand. Succession to class C occurs after 30yrs resulting in a mature closed-canopy stand.

This class originally was considered a closed, mid-development stage with 41-100% cover; however, it was changed to 21-100% cover and an all structure stage to account for the possibility that the cover might be lower at times.

Class C **25%**

Late Development 1 Closed

Indicator Species* and Canopy Position

POTR5 Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	41%	100%
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Description

Closed-canopy, relatively pure aspen stand (>10m) with large overstory trees. Fire frequency highly variable depending upon site location and adjacent vegetation. A 60yr MFI was originally used for the model and results generally in overstory mortality. Reviewers recommended a 100yr MFI, which was incorporated into the model.

Aspen always suckers. Suckering and recruitment might be impeded because of overstory auzin transport, but is infrequently eliminated, unless there are other root problems with the clone. Existing data suggest that aspen can persist in the understory of conifers as a shrub for relatively long periods of time (Dan Kashian, personal communication).

Browsing more than likely occurred on suckers in the pre-disturbance state and will likely again occur post disturbance. Further, herbivory is ubiquitous across the range of this BpS (Romme et al. 1995). Browsing is therefore consistently incorporated into the model.

Without herbivory, this condition can persist indefinitely with continued regeneration and overstory recruitment. The cumulative effect of sustained herbivory will eventually result in an open canopy mature stand (class D) due to canopy die-off and a lack of recruitment. Herbivory occurs with a probability of 0.01.

Any reduction of canopy auxin transport because of mixed or replacement fire will stimulate the suckering response.

Reviewers for MZ21 also recommended adding mixed severity fire at 100yrs and replacement fire at 100yrs. For MZ20, this mixed severity fire was included at 150yr return interval, since conifers of varying fire susceptibility also can be present. It is thought that perhaps 20% of the entire BpS would be affected by mixed severity fire, versus replacement.

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Subalpine fir might be comining in in the understory, as per reviewers of this model.

Insect/diseases outbreaks are believed to occur every 200yrs on average causing stand thinning (transition to class D).

Succession maintains vegetation in this class, however without disturbance and under certain site conditions a small percentage of this class may transition to mixed conifer forest (class E). This occurs every 200yrs.

Structure overlaps between C and E. However, the classes are distinguished by aspen versus mixed conifer.

Class D 25%

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

POTR5	Upper
ARTR2	Lower
GRASS	Lower
PSME	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	40%
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Aspen (>10m) widely spaced, open canopy existing until the overstory succumbs to mortality. This is a transitional state caused by insects, disease, herbivory or interactions among these factors. Continued moderate to high herbivory, which originally takes the site from class C, prevents the recruitment of overstory trees. Native herbivory was added to the model at a 0.01 probability but keeps the class in D.

Mean FRIs for fire are highly variable but a MFI of 60yrs was originally used for the model, but changed to 100yrs as per reviews.

In the absense of fire this state transitions to conifer, sagebrush or grassland dominated (Class E). This was modeled as a main successional pathway that occurs after approximately 100yrs.

Reviewers state that in the southern portion of this mapzone, this would transition to ABLA instead of PSME. PICO and ABLA would occur in the lower, middle and upper canopies. Fire would create suckers in the holes allowing aspen to persist in this stage. Fires might also remove some of the conifers.

Reviewers recommended adding in insects/disease disturbance at 0.005 probability; this was input into the model with little impact. There is thus far no data to support the impact of insects/disease.

Class E 15%

Late Development 2 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PSME	Upper
PICO	Upper
PIEN	Upper
ARTR2	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41%	100%
Height	Tree 10.1m	Tree 25m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

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Class E is a catch-all category that represents aspen replaced by other vegetation types or a mixed aspen-conifer overstory that is changing to a conifer dominated forest. If aspen persists in the understory, parent root material remaining on site allows aspen regeneration after fire. Replacement fire was originally modeled at every 60yrs but was changed to a 100yr frequency based on review.

Reviewers stated that an occasional aspen tree will be present in the overstory. If stand-replacing fire occurs, aspen will sucker. ABLA would be present in high amounts in the upper canopy as well.

Structure overlaps between C and E. However, the classes are distinguished by aspen versus mixed conifer.

Disturbances

Fire Regime Group:** IV

Historical Fire Size (acres)

Avg 100
Min 1
Max 1000

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	120	4	200	0.00833	84
Mixed	625			0.0016	16
Surface					
All Fires	101			0.00994	

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

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010451 Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest - Ponderosa Pine-Douglas-fir

☐ *This BPS is lumped with:*

☑ *This BPS is split into multiple models:* *This model represents areas where lodgepole pine is absent. This split is typically found on well-drained, thin soils, generally on relatively warm settings. However, this split also includes cooler, more mesic sites in the Missouri Breaks.*

In the Missouri Breaks, this BpS is generally found on northerly aspects or in narrow coulees, on clayey soils with slow permeability. Sites are always sloped and are usually steep.

See biophysical site description for elevational differences.

General Information

Contributors (also see the Comments field) **Date** 4/7/2006

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Vegetation Type

Forest and Woodland

Map Zone

20

Model Zone

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

Dominant Species*

PIPO PRVI
PSME JUSC
JUCO MARE
SYAL PICO

General Model Sources

☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

Northern Rocky Mountains in north and central MT.
This BpS is split into two models for the island mountain ranges of MZ20 (Moccasins, Judiths, Bear Paws, Little Rockies, Sweetgrass Hills and Snowies). This split represents areas where ponderosa pine is present and lodgepole pine is absent or not well-represented. The other split represents areas where lodgepole pine is well-represented.

Biophysical Site Description

This ponderosa pine BpS split is found on well-drained, thin soils, generally on relatively warm settings. In the Missouri Breaks, however, it includes relatively cool, moist areas. In the Missouri Breaks, this BpS is generally found on northerly aspects or in narrow coulees on clay soils with slow permeability. Sites are always sloped and are usually steep.

Elevation ranges from 2200-6500ft. On southerly aspects, elevation ranges from 4000-6500ft. On northerly

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aspects, elevation ranges from 4000-4500ft. In the Breaks, elevation ranges from 2200-3500ft.

Vegetation Description

In MZ20, ponderosa pine is generally the dominant species on southerly aspects and drier sites, with Douglas-fir dominating on northerly aspects and more mesic sites.

Southerly aspects support relatively open stands. Northerly aspects support more closed stands. On mesic sites with longer fire return intervals, Douglas-fir often co-dominates the upper canopy layers. In the absence of fire in any setting, Douglas-fir dominates stand understories.

In this split for ponderosa pine, it is possible that lodgepole could be present in the island mountain ranges but it is poorly represented. Lodgepole pine is absent in the Missouri Breaks. At lower elevations in the Snowy Range, hybrids can occur of Engelmann and white spruce.

The understory shrubs in the island ranges are dominated by snowberry, common juniper, common chokecherry, Oregon-grape, white spiraea, ninebark and kinnikinnik. Other shrubs on cool sites include Rocky Mountain maple and paper birch. On cool slopes, especially in the Little Rockies, paper birch and aspen will pioneer alongside conifers. Common understory forbs and graminoids include arrowleaf balsamroot, heartleaf arnica, Idaho fescue, Columbia needlegrass, pinegrass and bluebunch wheatgrass.

Understory shrubs in the Missouri Breaks are dominated by Rocky Mountain juniper (shrub form), snowberry and common chokecherry. Other common shrubs include rose and currant. Common forbs and graminoids include yarrow, carex, western wheatgrass and prairie sandreed.

Common montane habitat types include warm dry Douglas-fir and moist Douglas-fir, including: PSME/SYAL/AGSP and PSME/SYAL/SYAL, PSME/CAGE (mostly DF in PSME/CAGE - too high for PP, too dry for LP, can have Pifl and Pial), PSME/ARUV and PSME/LIBO/SYAL (although PIPO present west MT, absent eastward for PSME/LIBO/SYAL), PSME/AGSP, PSME/FESC, PSME/SPBE, PSME/CARU/PIPO and PSME/CARU/AGSP. In the Bear's Paw Mountains, another common habitat type is: PSME/COCA/LIBO. In the Snowy Mountains: PICEA/LIBO. In the Breaks: PSME/SYAL; PSME/JUSC (Rocky Mountain Juniper) and PSME/MUCU (Plains muhly).

Disturbance Description

Consists of Fire Regime Groups I and III with low and mixed severity fires at varying intervals (MFIs range from 10-80yrs).

Occasional replacement fires may also occur. Mixed severity fire increases and surface fires decreases on relatively mesic sites and on north-facing slopes in the Breaks due to more fuel-limited terrain.

Insects and disease play an important role, especially in the absence of fire. Bark beetles such as mountain pine beetle, western pine beetle and Douglas-fir beetle are active in the mid and late structural stage, especially in closed canopies. Ips beetles can be active in all structural stages, especially associated with other disturbances such as drought or windthrow.

Weather related disturbances, including drought, tend to affect the late closed structure more than other structural stages. Windthrow disturbances affect mid and late structural stands.

Western gall rust is the dominant disease on pine and increases in occurrence with lack of fire.

Root rot and mistletoe are minor concerns in the northern extent of this BpS.

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Adjacency or Identification Concerns

Because of fire suppression, xeric ponderosa pine types may be invaded by Douglas-fir today. It may be especially difficult in fire suppressed areas to distinguish between ponderosa pine and ponderosa pine-Douglas-fir BpS units. Other than elevational range differences, it may be difficult to distinguish between this BpS split and 1054 - Southern Rocky Mountain Ponderosa Pine Woodland mid and late closed seral states. Please see elevational descriptions in the site description for differences between the types.

The mixed conifer zone in the Northern Rockies is broad, and represents a moisture and temperature gradient that affects fire regimes and species dominance. This BpS split out (excluded) areas dominated by PICO.

At lower elevations or southerly aspects, this type generally borders dry ponderosa pine, shrub or grassland systems (BpS 1054). At higher elevations or on northerly aspects, this split (1045PP) borders the lodgepole split (1045LP). At higher elevations or northerly aspects in the Snowies and Sweetgrass Hills, it borders spruce and subalpine fir. In the other island ranges, spruce and fir are minor components.

At ecotones, it may be very difficult to distinguish between this BpS and 1053 (Northern Rocky Mountain Ponderosa Pine Woodland) in mid and late-closed seral states. (BpS 1166 seems to fit the island ranges of central Montana; however, BpS 1166 is not being modeled for MZ20, as BpS 1045 sufficiently addresses that system.)

Native Uncharacteristic Conditions

Canopy closure of >80% is considered to be uncharacteristic for this BpS.

Scale Description

Patch sizes were probably highly variable. Surface and mixed severity fires may have been variable in size, and potentially achieve large sizes due to wind influence (10s to 1000s of acres), with patchy fires in rocky, fuel limited terrain, and larger fires occurring in areas bordering continuous forest or grassland fuel.

Issues/Problems

Comments

Originally, the MZ20 model was created by Steve Cooper, Lee Clark, Dan Rasmussen, Jim Roessler and Shannon Downey Iverson and was adapted from model for 1910451 created by Steve Rust, Larry Kaiser and Kathy Geier-Hayes. Changes to description and species were made as well as significant changes to model and fire intervals. Model was unsplit for MZ20. However, review of the model led to splitting the system between lodgepole and ponderosa pine. Additional modelers for the split effort were Dan Rasmussen and Steve Cooper. Original modelers were contacted to receive input on new split model. Steve Barrett was a reviewer of the split model; however, he provided most of the input regarding the probabilities and successional pathways; therefore, his input is regarded as a modeler's input.

For MZ19, additional reviewers included Cathy Stewart (cstewart@fs.fed.us), Pat Green (pgreen@fs.fed.us), Steve Rawlings (srawlings@fs.fed.us), Catherine Phillips (cgphillips@fs.fed.us), Lyn Morelan (lmorlan@fs.fed.us), Susan Miller (smiller03@fs.fed.us) and Steve Barrett (sbarrett@mtdig.net).

Peer review for MZ19 resulted in changes to the description and a slight reduction in the overall fire frequency.

The MZ19 BpS was adapted from RA PNVG R0PPDF by Lynette Morelan and Jane Kapler Smith and was

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reviewed by Pat Green, Cathy Stewart and Steve Barrett. Modifications to the Rapid Assessment model included a slightly increased fire frequency. Relative proportions of surface, mixed and replacement fire were unchanged. The resulting percentages in classes C and D changed slightly.

Vegetation Classes

Class A 10%

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Description

Indicator Species* and Canopy Position

PIPO	Upper
PSME	Upper
	Upper
	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Some sites exhibit resprouting shrubs such as common chokecherry as the dominant lifeform. Other sites may be dominated by grasses or sedges.

Cool sites may include scattered deciduous trees in the canopy (birch and aspen).

Openings of shrubs, grass and forbs are created by infrequent, stand replacement fire. Seedlings and saplings are PSME and PIPO.

Resprouting shrubs such as snowberry, common chokecherry, rose, spiraea and ninebark are dominant in the understory. Dominant forbs and grasses may include arnica, yarrow, pinegrass and sedges. Depending on site, additional understory shrub species may include serviceberry, skunkbush sumac, russet buffaloberry and Ribes spp.

After 30yrs, this class succeeds to B (mid-closed). This class can take an alternate successional pathway to a mid-development open stage (class C), with a probability of .01.

Replacement fire occurs every 400yrs (.0025 probability), setting this class back to its beginning state. Mixed severity fires (every 200yrs) and low severity fires (every 40yrs) occur but do not cause a transition.

Weather disturbances occur every 500yrs (.002 probability or .2% of this class each year), and cause a transition back to the earliest state.

Class B 15%

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Description

Indicator Species* and Canopy Position

PIPO	Upper
PSME	Mid-Upper
	All
	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	70 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Understory initially has abundant herbaceous/shrub cover which decreases without disturbance.

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Pole to medium sized PIPO, with sapling to pole-sized PSME. Also contains medium sized PIPO with some large, pole to medium sized PSME.

After a period of 80yrs, this class moves to E, a late development closed stage.

After a period of 60yrs, regeneration contributes to ladder fuel so that stand replacing fire is more likely and returns to class A. Replacement fire will return this class to A (every 200yrs).

Mixed severity fires occur every 50yrs and create gaps that bring this class to a mid-open stage. Low-severity fires (every 100yrs) maintain this class.

Disturbances other than fire can create gaps and cause a transition to the mid-open stage. Wind/weather events (drought or windthrow) and insect/disease (beetles) occur with a probability of 0.002 (every 500yrs, or 0.2% of this class each year). Also, competition/maintenance occurs, maintaining this closed class, with a probability of 0.002.

Class C **20 %**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	All
PSME	All
	All
	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	30 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

This is a stage maintained by fires and disturbances.

Medium sized PIPO with some large, pole to medium sized PSME. Also contains pole to medium sized PIPO, and sapling to pole-sized PSME.

This class succeeds to the late development open stage, class D, after 80yrs. If fire does not occur for 40yrs, then this class will succeed to the mid-development closed stage.

After a period of 60yrs, regen contributes to ladder fuels so that stand replacing fire is more likely and returns to class A.

Replacement fires occur every 400yrs. More openings are creaated by low-severity (every 25yrs) and mixed severity (every 100yrs) fire and other disturbances such as wind/weather events every 200yrs and insect/disease every 200yrs. Regen is developing in openings.

Class D **40 %**

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper
PSME	Upper
	Lower
	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	60 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

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Description

Fire resistant stands of large PIPO and PSME.

Surface fires, mixed fires, and insects/pathogens will maintain the open condition. Eventually, replacement fire or another significant disturbance will cause a transition to class A. The disturbance transitions are similar to those in the mid-open stage, although there might be more frequent fire due to more fuel.

Replacement fire occurs every 400yrs. Mixed fire (every 140yrs) and low-severity fire (every 20yrs) occur and maintain this class.

Other disturbances such as wind/weather events (every 500yrs or 0.002 probability) and insects/disease (every 300yrs or 0.003 probability) occur and maintain this stage.

In the absence of fire for 40yrs, this class will move to class E, the late development closed stage.

Class E 15%

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper
PSME	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	80 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Dense canopy cover of large PIPO and PSME.

Replacement fire occurs every 150yrs. Mixed severity fires occur every 80yrs, opening the canopy and bringing this stage to the open state. Low-severity fires occur every 100yrs but cause no transition.

Wind/weather events and insects/pathogens occur with a probability of 0.002 and cause a transition to the late-open stage. Also, competition/maintenance occurs, maintaining this closed class, with a probability of 0.002.

Disturbances

Fire Regime Group:** I

Historical Fire Size (acres)

Avg
Min
Max

Sources of Fire Regime Data

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	300			0.00333	6
Mixed	100			0.01	19
Surface	25			0.04	75
All Fires	19			0.05333	

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.

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Additional Disturbances Modeled

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

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010454 Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest - Lodgepole Pine

☐ *This BPS is lumped with:*

☑ *This BPS is split into multiple models: This represents areas where LP is well represented. This BpS split is found on well-drained, thin soils, generally on relatively cool settings. See biophysical site description for elevational differences.*

General Information

Contributors (also see the Comments field) **Date** 4/7/2006

Modeler 1	Bruce Reid	breid@blm.gov	**Reviewer**	Steve Barrett	sbarrett@mtdig.net
Modeler 2	Jennifer Walker	jswalker@blm.gov	**Reviewer**	Cathy Stewart	cstewart@fs.fed.us
Modeler 3	Dan Rasmussen	dr4ester@msn.com	**Reviewer**	LaWen Hollingsworth	lhollingsworth@fs.fed.us

Vegetation Type

Forest and Woodland

Map Zone

20

Model Zone

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

Dominant Species*

PICO ARUV
PSME CARU
JUCO CAGE
SYAL

General Model Sources

☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range

Northern Rocky Mountains in western, north and central MT.

This BpS is split into two models for the island mountain ranges of MZ20 (Moccasins, Judiths, Bear Paws, Little Rockies, Sweetgrass Hills and Snowies). This split for lodgepole pine describes areas where PICO is well represented. The other split is for where ponderosa pine occurs.

Biophysical Site Description

In the island ranges, this BpS split is found on well-drained, thin soils, generally on relatively cool settings.

Elevation ranges from 4500-9000ft. On the southerly aspects, it ranges from 6500-9000ft. (9000ft in the Snowies). On the northerly aspects, it ranges from 4500-6500ft.

Vegetation Description

Lodgepole pine is present and well represented. Douglas-fir co-dominates or dominates the canopy and dominates the understory on all but the higher elevation northerly aspects. At higher elevations or on northerly aspects, spruce and subalpine fir are a minor component. (larch and grand fir is NOT present - they occurs west of Continental Divide)

Understory shrubs are dominated by common juniper, Oregon-grape, kinnikinnik, snowberry, white spiraea,

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ninebark and whortleberry. Other shrubs include Rocky Mountain maple and paper birch. On the cool sites of this split, especially in the Little Rockies, paper birch and aspen will pioneer alongside conifers. Common chokecherry is absent or poorly represented in stands dominated by PICO of this BpS. Common forbs and graminoids include heartleaf arnica, twinflower, elk sedge and pinegrass.

Common habitat types include: PSME/SYAL/CARU, PSME/JUCO, PSME/PHMA (although for PSME/PHMA, PICO and PIPO are rarely present east of the divide - it's mostly DF cover), and PSME/LIBO/CARU, PSME/LIBO/VAGL. PSME/CARU/CARU with Pial possible. In the Bear Paw Mountains: PSME/COCA-LIBO. In the Snowy Mts: PICEA/LIBO. This BpS split corresponds to Fire Group Seven: cool habitat types usually dominated by lodgepole pine (including some of above and PSME/COCA-VAMY and PICO/LIBO.)

Disturbance Description

Consists of Fire Regime Groups III, IV and V, with mixed severity and replacement fires occurring at varying intervals, but generally less than 100-150yrs. Stand replacement fires are more common where lodgepole pine is a significant component, and these stands become more likely to burn after 60-80yrs.

Lodgepole pine can dominate the understories in open canopy stands with the influence of low severity surface fires.

Insects and disease play an important role, especially in the absence of fire. Bark beetles such as mountain pine beetle, western pine beetle and Douglas-fir beetle are active in the mid and late structural stage, especially in closed canopies.

Weather related disturbances, including drought, tend to affect the late closed structure more than other structural stages. Windthrow events can be extensive and affect stands of this type in all but early stage structure.

Western gall rust is the dominant disease on lodgepole and ponderosa pine and increases in occurrence with lack of fire.

Root rot and mistletoe are minor concerns in the northern extent of this BpS.

Adjacency or Identification Concerns

The mixed conifer zone east of the Continental Divide is broad, and represents a moisture and temperature gradient that affects fire regimes and species dominance. This BpS split addresses areas dominated by lodgepole pine.

At lower elevations or on southerly aspects, this BpS split (LP) borders the other split (PP). At higher elevations or northerly aspects, it includes spruce and subalpine fir in the Snowies and the Sweetgrass Hills. In the other island ranges, spruce and fir are a minor component.

It may be difficult to distinguish between this BpS split and 1050 (Rocky Mountain Lodgepole Pine Forest), but this BpS split for the island ranges of MZ20 does not have many true lodgepole pine series habitat types and can be instead identified by virtue of presence of co-dominant Douglas-fir. BpS 1166 seems to fit the island ranges of central MT; however, BpS 1166 not considered to occur in MZ20, but rather 1045.

Native Uncharacteristic Conditions

Canopy closure of >80% is considered to be uncharacteristic for this BpS.

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Scale Description

Patch sizes were probably highly variable because of topography and associated differences in vegetation. Mixed severity fires may have been highly variable in size. Stand replacement fires could (and do) potentially achieve large sizes due to wind influence (100s to 1000s of acres).

Issues/Problems

Determining mapping attributes may be difficult given the rough similarity of some succession class stages to those in other PICO dominated BpSs, especially along lower elevation ecotones between the montane and subalpine zones.

Comments

Originally, the MZ20 model was created by Steve Cooper, Lee Clark, Dan Rasmussen, Jim Roessler and Shannon Downey Iverson and was adapted from model for 1910451 created by Steve Rust, Larry Kaiser and Kathy Geier-Hayes. Changes to description and species were made as well as significant changes to model and fire intervals. Model was initially unsplit for MZ20. However, review of the model led to splitting the system between lodgepole and ponderosa pine. New modelers for the split effort are listed in modeler section, as well as Steve Cooper. Original modelers were contacted to receive input on new split model.

For MZ19, additional reviewers included Cathy Stewart (cstewart@fs.fed.us), Pat Green (pgreen@fs.fed.us), Steve Rawlings (srawlings@fs.fed.us), Catherine Phillips (cgphillips@fs.fed.us), Lyn Morelan (lmorlan@fs.fed.us), Susan Miller (smiller03@fs.fed.us) and Steve Barrett (sbarrett@mtdig.net).

Peer review for MZ19 resulted in changes to the description and a slight reduction in the overall fire frequency.

This BpS for MZ19 was adapted from RA PNVG R0PPDF by Lynette Morelan and Jane Kapler Smith and was reviewed by Pat Green, Cathy Stewart and Steve Barrett. Modifications to the Rapid Assessment model included a slightly increased fire frequency. Relative proportions of surface, mixed and replacement fire were unchanged. The resulting percentages in classes C and D changed slightly.

The Rapid Assessment included two additional grand fir types. There was some disagreement among modelers and reviewers about whether two or three types should be developed from this BpS to capture slight differences in fire regimes. The BpS was not split.

Vegetation Classes

Class A **15%**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Description

Indicator Species* and Canopy Position	
PICO	Upper
	Upper
	Upper
	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0%	100%
Height	Tree 0m	Tree 5m
Tree Size Class	Seedling <4.5ft	

☐ Upper layer lifeform differs from dominant lifeform.

Some sites exhibit resprouting shrubs like snowberry as the dominant lifeform. Other sites may be dominated by graminoids such as pine grass (calamagrostis rubescens).

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Openings of grass and forbs are created by infrequent, stand replacement fire. Seedlings and saplings are dominated by PICO.

Resprouting shrubs such as snowberry, Oregon-grape, ninebark and whortleberry are dominant in the understory. Dominant forbs and grasses may include arnica, pinegrass and elk sedge.

After 20yrs, this class succeeds to B (mid-closed) unless a replacement (every 1000yrs) or mixed (every 1000yrs) severity fire occurs.

Wind/weather stress events (drought) occur with a probability of .002 (.2% of this class on the landscape each year).

Insect/disease (beetles, western gall rust) occur with a probability of .001 (.1% of this class each year).

Class B 45 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PICO	Upper
PSME	Lower
	Middle
	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	80 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

The understory is usually depauperate in this mid-closed canopy.

Description

Sapling to pole sized lodgepole pine.

Replacement fire will return this class to A, every 200yrs. Surface fires are rare (every 200yrs), but would maintain the class.

After a period of 70yrs, this class moves to the late development closed stage. Disturbances other than fire such as insect/disease (as above) every 100yrs (0.01 probability) and wind/weather (drought or windthrow) every 100yrs (0.01 probability) can create gaps and cause a transition to the mid-development open stage.

Class C 15 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PICO	Upper
PSME	Lower
	Lower
	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	60 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

This is a disturbance-caused mid-development open canopy stage.

This class succeeds to the late development open stage after 70yrs. In the absence of fire, this class will move to the mid closed stage after 60yrs.

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Replacement fire, though rare (every 200yrs), may return this class to A.

Mixed fire occurs every 100yrs.

Insect/disease occurs every 100yrs (0.01 probability) and wind/weather (drought or windthrow) every 100yrs (0.01 probability) can create gaps and maintain this stage.

It is thought that the open classes (C and D) might comprise approximately 10-15% of the landscape each.

Class D 10%

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PICO	Upper
PSME	Low-Mid
	Lower
	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21%	60%
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Replacement fire will cause a transition to class A (early development) every 200yrs. Surface fires (every 50yrs), mixed fires (every 30yrs), insects (every 50yrs) and wind/weather stress events (every 50yrs) will maintain the open condition.

If this class escapes fire for 60yrs, it will succeed to class E (late-development closed).

It is thought that the open classes (C and D) might comprise approximately 10-15% of the landscape each.

Class E 15%

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PICO	Upper
PSME	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61%	90%
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

At 90yrs this system will be small diamater lodgepole pine dominated in a closed canopy condition. The lodgepole pine component is becoming decandant and breaking up with Douglas-fir as a major understory component and minor ponderosa pine coming in as another understory component on warm sites.

Replacement fire (every 50yrs) will return this class to A. Mixed fire (every 1000yrs) or other disturbances, such as insects every 50yrs or wind/weather every 50yrs, can open the stand and convert this class to class D. Surface fires are rare (every 1000yrs), but would maintain the class.

Disturbances

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Fire Regime Group:** III

Historical Fire Size (acres)

Avg
Min
Max

Sources of Fire Regime Data

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

Additional Disturbances Modeled

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

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	150			0.00667	52
Mixed	275			0.00364	28
Surface	400			0.0025	20
All Fires	78			0.01280	

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.

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010460 Northern Rocky Mountain Subalpine Woodland and Parkland

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

General Information

Contributors (also see the Comments field) **Date** 11/18/2005

Modeler 1	Larry Kaiser	larry_kaiser@blm.gov	**Reviewer**	Dana Perkins	dana_perkins@blm.gov
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Modeler 3	Randall Walker	rmwalker@fs.fed.us	**Reviewer**	John DiBari	jdibari@email.wcu.edu

Vegetation Type
Forest and Woodland

Map Zone
20

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

Dominant Species*
PIAL PIFL
ABLA
PIEN
LALY

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Western MT and northern and central ID. Limited distribution in northeastern OR and WA.

Biophysical Site Description
Upper subalpine zone (6000-9500ft) on moderate to steep terrain (eg, 40-70% slope). Landforms include ridgetops, mountain slopes, glacial trough walls and moraines, talus slopes, land and rock slides, and cirque headwalls and basins. Some sites have little snow accumulation because of high winds and sublimation, which increases summer drought.

Patchy distribution of this type may be controlled by edaphic conditions, including soil depth and susceptibility to summer drought.

Vegetation Description
Forest communities range from nearly homogeneous stands of five-needled pines on harshest, highest elevation sites to mixed species, including shade tolerant firs, on more protected sites. Vegetation is stunted with short, dwarfed trees, including krumholz vegetation on the harshest sites. Historically, whitebark pine dominated on southerly aspects, while northerly aspects were dominated by alpine larch or subalpine fir and Engelmann spruce. Lodgepole pine may be present as an early succession species. Limber pine may be present in southeast and eastern ID, but in these mapping zones it is not typically a subalpine species (it favors lower treeline habitat). In this harsh windswept environment trees are often stunted and flagged from wind damage.

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Whitebark pine is a keystone species in many of these forests. Mature whitebark pine trees ameliorate local conditions on harsh sites and facilitate the establishment of less hardy subalpine species. The seeds of whitebark pine provide an important food source for wildlife, particularly grizzly bears and Clark's nutcrackers. Whitebark pine also depends exclusively upon Clark's nutcrackers for seed dispersal and subsequent tree establishment.

Disturbance Description

Fire Regime Groups III and IV, primarily long-interval (eg, 100-200yrs+) mixed severity (25-75% top kill) and stand replacement fires. Ignitions are frequent due to lightning, though fires seldom carry due to lack of fuel from the slow-growing vegetation. Individual tree torching is more common. Nonlethal surface fires may dominate where continuous light fuel loading (ie, grasses) exists (Kapler-Smith and Fischer 1995), but fires would typically be small in extent and are not modeled here. Recent dendroecological data collected in whitebark pine forests near Missoula, in western MT, found numerous small fires (MFIs <50yrs) punctuated by less frequent, larger fires (MFIs 75-100yrs) and implicated large-scale climate variability (eg, the Little Ice Age) as a driver of temporal changes in the fire regimes of these forest systems (Larson 2005).

The mountain pine beetle is an important disturbance agent in whitebark pine and lodgepole pine forests, and past outbreaks have caused widespread mortality in these forest types throughout the region. Spruce budworm may be present on higher density spruce sites. Snow, wind and other weather events may cause damage and cause transitions between classes.

Adjacency or Identification Concerns

This BpS corresponds to cold upper subalpine and timberline habitat types (Pfister et al. 1977, Steele et al. 1983 and Cooper et al. 1991), including ABLA/LUHI, PIAL/ABLA, LALY/ABLA, PIAL/LALY and ABLA/XETE. Lower subalpine forests border at lower elevations, including lodgepole pine, Douglas-fir, Engelmann spruce and subalpine fir types. Successional trajectory towards more shade tolerant species in absence of fire.

Whitebark pine blister rust has decimated whitebark pine in moist ranges of this BpS (eg, near Glacier National Park). Mountain pine beetle is a natural agent of mortality affecting five-needle pines. Infestations occur periodically and are a natural agent of disturbance in these systems.

Early grazing, fire suppression and climate change may have altered natural fire frequency. Live and dead trees are potential dendro-climatic resources.

Native Uncharacteristic Conditions

Scale Description

Fires could range from individual trees to 100s of acres, though topography and continuity of fuel beds influence fire spread.

Issues/Problems

Empirical data for the upper subalpine forest is generally sparse; the quantification of fire regimes, succession and other disturbances continues.

Comments

For MZ20, this BpS was adopted as-is by MFSL from MZ19.

For MZ19, additional reviewers included Steve Barrett (sbarrett@mtdig.net), Evan Larson (lars2859@umn.edu), Susan Miller (smiller03@fs.fed.us), Steve Rawlings (srawlings@fs.fed.us) and Cathy

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**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.

Stewart (cstewart@fs.fed.us).

Peer review resulted in changes to the description, but no changes to the model. Two reviewers disagreed about the fire frequency-- one suggesting it be changed to 150yrs MFI, another suggesting it be changed to ~100yrs. No changes were made to the MFI.

Based on Rapid Assessment model R0WBLP by Steve Barrett and reviewed by Cathy Stewart. Adjustments for MZs 10 and 19 resulted in additions to the description and an increased fire frequency (from 155yrs to 133yrs MFI).

This model was imported from Z19 by Brendan Ward.

10/11/07: 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.

Vegetation Classes

Class A 20%

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIAL	Upper
LALY	Upper
PICO	Upper
PIFL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Higher elevation sites will be dominated by herbaceous species.

Description

Early succession after moderately long to long interval replacement fires and highly variable interval mixed severity fires. Whitebark pine, limber pine and subalpine larch will typically be early pioneers. Lodgepole pine may be present.

Wind, weather, insects, disease and replacement fire from all succession classes cause a transition to class A. This class will transition to class B after approximately 50yrs, although limited resources may cause this class to persist longer.

Class B 40%

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIAL	Upper
ABLA	Upper
PIEN	Mid-Upper
PICO	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Stands dominated by small-diameter with a mix of shade tolerant and intolerant species. High elevation or harsh sites may exhibit krummholz growth form. Whitebark pine and subalpine larch will typically be early pioneers on harsh sites.

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**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 E at 130yrs.

Class C **15 %**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIAL	Upper
LALY	Upper
PICO	Upper
PIFL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	30 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Stands dominated by small-diameter with a mix of shade tolerant and intolerant species. High elevation or harsh sites may exhibit krummholz growth form. Whitebark pine (especially on southerly aspects) and subalpine larch (especially on northerly aspects) will typically be early pioneers on harsh sites. Limber pine may also occur on these sites.

This class succeeds to D at 130yrs.

Class D **5 %**

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIAL	Upper
LALY	Upper
PICO	Upper
PIFL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	40 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Mid to large diameter mixed conifer species in small to moderate size patches generally on southerly aspects. Open canopy conditions occur on sites where soil is less developed or on wind-exposed, south-facing aspects. Whitebark pine (especially on southerly aspects) and subalpine larch (especially on northerly aspects) will typically dominate.

This class will persist until a disturbance causes a transition.

Class E **20 %**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIAL	Upper
ABLA	Upper
PIEN	Upper
PIFL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Mid to larger diameter mixed conifer species in small to moderate size patches generally on southerly aspects. Subalpine fir is likely to be encroaching upon these sites. Closed canopy conditions occur on sites that are more

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**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.

protected (ie, northerly aspects) or have better soil development.

This class will persist until a disturbance causes a transition.

Disturbances

Fire Regime Group:** III

Historical Fire Size (acres)

Avg 0
Min 10
Max 1000

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	400	100	1000	0.0025	40
Mixed	270			0.00370	60
Surface					
All Fires	161			0.00621	

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
- [ ] Native Grazing
- [x] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

References

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**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010490 Rocky Mountain Foothill Limber Pine-Juniper Woodland

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

General Information

Contributors (also see the Comments field) **Date** 6/13/2006

Modeler 1 Steve Barrett	sbarrett@mtdig.net	**Reviewer**	
Modeler 2		**Reviewer**	
Modeler 3		**Reviewer**	

Vegetation Type
Forest and Woodland

Map Zone
20

Model Zone

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

Dominant Species*

PIFL2	ARTR2
JUSC2	BOGR2
JUOS	LEKI2
ARNO4	POSE

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
Northern MT to central CO east of the continental divide, on escarpments across WY into the Black Hills. This is thought to occur in subsections M331Dm as well. In MZ20, this BpS is very limited in extent. It might occur along the Rocky Mountain Front; it commonly occurs in central MT as very narrow stringers along the prairie-coniferous forest ecotone.

Biophysical Site Description
Occurs in foothill and lower montane zones into the western Great Plains. Elevation ranges from 1000-2400m (3300-7900ft). Occurs in shallow, sandy soils with high rock component, often gravelly and calcareous. Slopes are moderately steep to steep, typically on rocky, well-drained, windswept, and nutrient-poor sites on exposed ridges and summits. This type is often found in locations too dry for other coniferous species, such as Douglas-fir.

Vegetation Description
Open canopy dominated by Pinus flexilis, Juniperus scopulorum and, to a lesser extent, Juniperus osteosperma. Pinus edulis is not present.

The shrubs layer is sparse to moderately dense. Shrubs may include Artemisia nova, Artemisia tridentata, Cercocarpus ledifolius, Cercocarpus montanus, Ericaneria nauseosa, Purshia tridentata, Rhus trilobata, Rosa woodsii and Ribes montigenum.

Herbaceous layers are sparse, often significantly different than surrounding community. These may include Bouteloua gracilis, Leucopoa kingii, Hesperostipa comata, Koeleria macrantha, Pipatherum micranthum, Poa secunda and Pseudoroegneria spicata. AGSP and FEID are other dominants and major habitat types in the northern/central portions of the zone.

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Disturbance Description

Limber pine bark at the base of older trees may be 2in (5cm) thick, therefore these trees can withstand stem scorch from low-severity fires. Terminal buds are somewhat protected from the heat associated with crown scorch by virtue of an open branching habit and the tight clusters of needles around them. Wildfires are less frequent in limber pine communities than in other conifer habitats because of low fuel accumulation associated with poor soil development and limited grass and forb productivity. Locations where limber pine grows may have a much lower fire frequency than surrounding communities. Surrounding community fire regime may have impact on limber pine (Johnson 2001).

A reviewer for MZ21 noted that these woodlands have the fuel structure of juniper woodlands with all fire intervals of several centuries (Anonymous).

Some reviewers for MZ21 felt that small surface fires occured every 30-40yrs and the mean fire interval could be between 100-300yrs, as per Bradley et al (1992); however, original modelers disagreed. Therefore, the longer interval was chosen for MZ21.

For MZ20, an FRG III scenario was chosen for two types of sites: rocky fuel-limited sites with an overall MFI of approximately 100yrs; and fuel abundant sites such as grassland prairies and continuously forested foothills with Douglas-fir co-dominant, with an overall MFI of 20-40yrs. This was modeled with a 50/50 split among these two ecotypes with an overall MFI of 50yrs with an 80/20 mixed severity fire versus replacement fire ratio. This scenario is thought to occur at least in the northern and central portions of the zone (Barrett 1999).

Adjacency or Identification Concerns

Where limber pine grows in association with other trees, the fire regimes of those species are relevant and affect fire return interval (Johnson 2001).

This species can be susceptible to white pine blister rust which can cause mortality. It is also susceptible to mountain pine beetle outbreaks.

Native Uncharacteristic Conditions

Cover >70% can be considered uncharacteristic in this woodland community.

Scale Description

Tens to 100s of acres, generally smaller islands of trees.

Issues/Problems

Fire history is lacking with a wide range of estimates available. As a whole, fire is rare in this BpS due to limited fine fuel. Review for MZ23 raises concern about the percent of replacement fire.

The model for MZ20 was changed to reflect a different understanding of this system in this mapzone; therefore, FRIs and percentages in classes vary from MZ21 and other mapzones (ie, MZ23 and MZ22) - due to differing opinions about this system. This model does not adhere to the belief that PIFL only occurs on rocky fuel limited sites and thus belongs in long-interval fire regimes, as modeled in other mapzones.

Comments

This model for MZ20 was adapted from the same BpS in MZ21, created by Don Despain (don_despain@usgs.gov) and LaWen Hollingsworth (lhollingsworth@fs.fed.us) and reviewed by Bill Romme, Liz Davy, Tim Belton and others as listed below. The model for MZ20 was changed to reflect a

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different understanding of this system in this mapzone; therefore, FRIs and percentages in classes vary from MZ21 and other MZs (ie, MZs 23, 22, 10 and 19) - due to differing opinions about this system. This model does not adhere to the belief that PIFL only occurs on rocky fuel limited sites and thus belongs in long-interval fire regimes, as modeled in other mapzones.

This model for MZ21 is based on the LANDFIRE model for 191049 created by Mike Babler (mbabler@tnc.org) and reviewed by Dennis Knight (dknight@wyo.edu), Vic Ecklund (vecklund@csu.org) and Paul Langowski (plangowski@fs.fed.us), but was adapted for MZ21 to better reflect local conditions. Descriptive and quantitative changes were made. Other reviewers for MZ21 included an anonymous reviewer in February 2006, and Lisa Heiser, Candi Eighme, Dennis Barron, Spencer Johnston and Heidi Whitlatch in March 2006.

For MZs 10 and 19, this model was adopted as-is from MZ28 with minor modifications to the description. Original model developed for MZs 23 and 24 by Mike Babler, (mbabler@tnc.org), 4/10/2005. Reviewed by D Knight (dhknight@wyo.edu). Further modified for MZ28 4/19/2005. Was also reviewed in workshop by Chuck Kostecka (Colo State Forest Service, ret.).

Vegetation Classes

Class A 20%

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

PIFL2	Upper
JUSC2	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	60 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Seedlings can be slow to establish. Competition from grasses and shrubs is variable depending on moisture availability. Adjacent grasslands, shrublands and Douglas-fir ecosystems can influence the fire regime. Trees <70yrs in this class; succession to an open late-development state occurs after 70yrs, although succession can occur bringing the class to a closed state with a probability of 0.01.

Replacement fire occurs every 50yrs. Surface fire does not occur in this class.

It is thought that there should be approximately 20% of the BpS in this class (stands occurring as grassland savannas) historically. See Gruell (1983).

Class B 50%

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

PIFL2	Upper
JUSC2	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	30 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

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Trees are established. Grasses and herbs can be sparse due to limited moisture. This class includes mid to late seral classes with an open canopy.

Low to mixed severity fire can often enter this system from adjacent grasslands, shrublands and Douglas-fir ecosystems.

This class can persist, although in the absence of fire for 150yrs, this class might succeed to a closed state.

Fire in this class was modeled according to an overall FRI of 50yrs, and partitioned between replacement fire 20% of the time and mixed fire 80% of the time, maintaining this class.

It is thought that there should be approximately 40% of the BpS in this class historically. See Gruell (1983).

Class C **30%**

Late Development 1 Closed

Indicator Species* and Canopy Position

PIFL2	Upper
JUSC2	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	50 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

☐ Upper layer lifeform differs from dominant lifeform.

Description

Trees are established. Grasses and herbs can be sparse due to limited moisture. This class includes mid to late seral classes with a denser canopy. Low to mixed severity fire can often enter this system from adjacent grasslands, shrublands and Douglas-fir ecosystems. Stand-replacing fire tends to occur under dry, windy conditions and may be impacted from fire brands from adjacent vegetation types.

Stands typically would be <50% cover and >70% cover would be uncharacteristic.

Fire in this class was modeled according to an overall FRI of 50yrs, and partitioned between replacement fire 20% of the time and mixed fire 40% of the time, bringing this class to an open stage, B, and low severity fire 40% of the time, maintaining this stage.

It is thought that there should be approximately 40% of the BpS in this class historically. See Gruell (1983).

Class D **0%**

[Not Used] [Not Used]

Indicator Species* and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class		

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model

☐ 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

Fire Regime Group:** **III**

Historical Fire Size (acres)

Avg 25
Min 1
Max 200

Sources of Fire Regime Data

☐ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals	*Avg FI*	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	135	100	500	0.00741	41
Mixed	115			0.0087	48
Surface	500	50	500	0.002	11
All Fires	55			0.01810	

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

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010500 Rocky Mountain Lodgepole Pine Forest

☑ *This BPS is lumped with: 1055*

☐ *This BPS is split into multiple models: 1050 and 1055 are lumped/identical. 1050 is seral to 1055 and should probably be dropped for this zone.*

General Information

Contributors (also see the Comments field) **Date** 6/13/2006

Modeler 1	Steve Barrett	sbarrett@mtdig.net	**Reviewer**	Cathy Stewart	cstewart@fs.fed.us
Modeler 2			**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type

Forest and Woodland

Map Zone

20

Model Zone

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

Dominant Species*

PICO	ARCO9
VASC	MARE11
ABLA	CAGE2
PIEN	

General Model Sources

☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

The Rocky Mountain Lodgepole Pine Forest BpS (1050) and 1055 occur throughout MZ21, including west-central WY, ranging from the eastern flanks of the Wind River Range west to the Bridger-Teton National Forest, north to the Gallatin Range and west towards Island Park, ID. It encompasses mid and upper elevations of the Bridger-Teton National Forest and portions of the Caribou Targhee in this mapzone. It is also found in subsections highlands M331Dm, M331Dd, M331Aa, M331Ae.

For MZ20, lower subalpine lodgepole pine is quite common (Pfister et al 1977).

Biophysical Site Description

Subalpine cold climate, dry-mesic but precipation usually comes in the winter months as snow, except at the eastern flanks of the Wind River Range where the majority of the precipitation occurs in the spring months. Soils are usually excessively well-drained, residual or glacial till and alluvium on valley floors, droughty moderately deep to deep soils over fractured granodiorite, quartzite and sandstone bedrock. Coarse fraction 30-50% in soil, soils moderately deep to deep to broken rock or bedrock. Soils are acidic, and rarely formed from calcareous parent materials. Biophysical setting 1050 occurs regularly and conspiciously on the Flathead Sandstone Formation along the entire eastern flank of the Wind River Range. Precipitation 400-900 mm/yr.

Vegetation Description

These forests are dominated by Pinus contorta and ABLA, PICEA, with shrub and grass. Sometimes there are intermingled mixed conifer/Populus tremuloides stands with the latter occurring with inclusions of deeper, typically fine-textured soils. The shrub stratum may be conspicuous to absent; common species include Arctostaphylos uva-ursi, Ceanothus velutinus, Mahonia repens, Spiraea betulifolia, Spiraea douglasii, Shepherdia canadensis, Vaccinium spp, Symphoricarpos oreophilus, Ribes viscosissimum,

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Sambucus cerulea, Pachistima myrinsites, Salix scouleriama and Prunus virginiana. Grasses include Elymus glauccus, Poa wheeleri, Carex rossii, Carex geyeri and Carex hoodii. Dominant forbs are Arnica cordifolia and Hieracium alboflorum.

Disturbance Description

These are subalpine forests where the dominance of Pinus contorta is related to fire history and topo-edaphic conditions. Following stand-replacing fires, Pinus contorta will rapidly colonize and develop into dense, even-aged stands depending on site characteristics and cone serotiny. In areas with low serotiny, the stands will be less dense and gradually seed in versus develop even-aged stands immediately. The mean FRI is variable depending on such factors as terrain, elevation, precipitation and temperature and often is influenced by neighboring fire regimes in more frequently burned adjacent forests and grasslands (ie, "contagion" effect).

For MZ20, the range is thought to be between 40-300yrs, with an overall MFI of 100yrs split between 70% stand replacing and 30% mixed severity fire regime.

At approximately 80-100yrs of age, insect, disease and/or blow down create small openings in forest canopy maintaining class B. Under favorable (extreme, 95% percentile) weather, early successional stands will burn where live herbaceous fuel load is sufficient to carry fire. Wind/weather events were not modeled.

Fire size is largely dependent on climatic conditions. During periods when summers are rarely dry, average fire size is about 100ac but when dry summers and fast-moving cold fronts occur, fire sizes can range from 1000-100000ac.

Fire frequency less than 300yrs will keep lodgepole pine on the landscape.

According to Fisher and Clayton (1983), fire return intervals at elevations >7500ft average 150yrs, but range from 300-400yrs in Yellowstone. In areas at <7500ft, fire return intervals vary from 100-500yrs with some recurring cool fires that thin stands without serious damage for this type (Novak, personal correspondence). However, Barrett's (2004) summary of data from all fire history plots in the Northern Rockies as of 2000 suggests widely ranging MFIs for lodgepole pine forests east of the Continental Divide. That is, presettlement MFIs were as frequent as every 30yrs between mixed severity fires (relatively dry lower elevation environments), to infrequent stand replacement (up to 300yrs in relatively cold-moist upper elevation terrain).

Adjacency or Identification Concerns

1050 is not a BpS in MZ21 but is a seral component of BpS 1055. This type was modified from 1810500 by adding class D, the spruce/fir climax that would occur without fire.

This should be distinguished from 1056, as 1056 is moister. Many of the tree species are similar, but shrub component is distinct. Reviewers for MZ20 were considering lumping this system with 1056, but decided not to based on moisture gradient and different shrub component.

BpS 1055 is also slightly lower in elevation than 1056.

Lodgepole pine stands in the montane and lower subalpine zones, that are on less well-drained soils, are usually seral to mixed conifer or subalpine BpS, including species such as Douglas-fir, Engelmann spruce, whitebark pine and subalpine fir. Some Pinus contorta forests will persist on sites that are too extreme (hot and dry) for other conifers to establish (BpS 1167). Persistent PICO is also found in frost pockets

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

(reviewers, MZ21).

Currently, balsam bark beetle is killing subalpine fir trees throughout the Rocky Mountain subalpine mesic spruce fir region.

This type is a subalpine forest, as opposed to the mixed conifer montane model of BpS 2010451.

Native Uncharacteristic Conditions

Scale Description

The Rocky Mountain Lodgepole Pine Forest occurs in large (100-1000s of acres) tracts often times following patterns of bedrock and/or surficial geology. The scale of disturbance is generally large, ranging from 100-1000s of acres. Microclimate may have significant influence on the patch size and mosaic of the disturbance.

Issues/Problems

BpS 1050 Rocky Mountain Lodgepole Pine Forest is a successional stage of BpS 1055 Rocky Mountain Dry Mesic Dry-Spruce-Fir Forest and Woodland. Fire frequency at <300yrs will keep lodgepole pine on the landscape.

The model for MZ20 was changed from the MZ21 model to reflect a different understanding of this system in this mapzone; therefore, FRIs and percentages in classes vary from MZ21 due to differing opinions about this system. The MZ21 model is focused on a Greater Yellowstone Ecosystem view, whereas this MZ20 model is not.

Comments

This model for MZ20 was adapted from the same BpS in MZ21 created by Don Despain, Aaron Wells and Vicky Edwards and reviewed by Bil Romme, Liz Davy and Tim Belton. The model for MZ20 was changed to reflect a different understanding of this system in this mapzone; therefore, FRIs and percentages in classes vary from MZ21 due to differing opinions about this system. The MZ21 model is focused on a Greater Yellowstone Ecosystem view, whereas this MZ20 model is not.

This model for MZ21 is based on the LANDFIRE model for BpS 1050 from MZ18 created by Sarah Heide (sarah_heide@blm.gov) and reviewed by Louis Provencher (lprovencher@tnc.org). This type for MZ21 was modified from 1810500 by adding class D, the spruce/fir climax that would occur without fire. Model for MZ21 was further reviewed by an anonymous reviewer in February and Heidi Whitlatch (hwhitlatch@fs.fed.us), David Barron (dbarron@fs.fed.us), Spencer Johnston (sjohnston@fs.fed.us), Candi Eighme (ceighme@fs.fed.us) and Lisa Heiser (lheiser@fs.fed.us).

Vegetation Classes

Class A **15%**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Description

Indicator Species* and Canopy Position

VASC	Lower
RIVI	Lower
CAGE2	Lower
PICO	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0%	100%
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Grasses, forbs, low shrubs and lodgepole seedlings-saplings. Succeeds to B after 20yrs because young lodgepole grows fast. If aspen is present, it grows faster and dominates lodgepole during this stage only. Cover of trees (seedlings-saplings) varies widely. This could be considered a grass stage unless there is a lodgepole seed source nearby (MZ21 reviewers).

Replacement fire occurs every 100yrs on average, setting back succession to age zero.

Class B 35 %

Mid Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PICO	Upper
VASC	Lower
CAGE2	Lower
ABLA	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Moderate to dense pole-sized trees, sometimes very dense (dog-hair). Closed canopy is 51-100%. Mid-open stands are at 21-50% canopy cover and would have mature and immature aspen present. Mid-open stands would have subalpine fir in the understory. Therefore, this class is considered a mid-development all-structures class.

Class will last until 80yrs and then succeed to C. Insects and disease (mean return interval of 75yrs) maintain class B. Competition may maintain the dog-hair condition (prob/yr = 1/500).

Fire was modeled with an overall FRI of 100yrs, split between 70% replacement fire and 30% mixed fire maintaining this stage.

Class C 20 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 10

Indicator Species* and Canopy Position

PICO	Upper
ABLA	Mid-Upper
VASC	Lower
CAGE2	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Many mature lodgepole pine, somewhat patchy, variety of lodgepole size classes and open canopies overall but patches of denser trees. This class lasts until 350yrs, then succeeds to the spruce fir class (class D). There is also a possibility that this transition could occur sooner, thus an alternative succession pathway was modeled at 0.01.

Insects rarely kill all, and they would rather cause a transition to class B (0.006 probability) or maintain it in C (0.006 probability).

Fire was modeled with an overall FRI of 100yrs, split between 70% replacement fire and 30% mixed fire bringing this stage back to B.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Class D 30 %

Late Development 2 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 10

Indicator Species* and Canopy Position

ABLA	Upper
PIEN	Upper
VAME	Lower
VASC	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	100 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Mature spruce/fir forest with a variety of size classes from seedling to mature. Insect and disease usually affects only one species so survivors trees of other species remain in the stand.

This class is distinguished from C by species, not canopy closure or tree height.

Reviewers state that spruce beetle could kill most of the spruce and transition this class back to class A. However, this scenario was not modeled.

Fire was modeled with an overall FRI of 100yrs, split between 70% replacement fire and 30% mixed fire maintaining this stage.

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:** III

Historical Fire Size (acres)

Avg 1000
Min 10
Max 100000

Sources of Fire Regime Data

- ☑ Literature
- ☑ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	135	90	350	0.00741	74
Mixed	385			0.0026	26
Surface					
All Fires	100			0.01001	

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

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**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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010530 Northern Rocky Mountain Ponderosa Pine Woodland and Savanna

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

General Information

Contributors (also see the Comments field) **Date** 11/18/2005

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Vegetation Type
Forest and Woodland

Map Zone
20

Model Zone

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

Dominant Species*
PIPO
FEID
PSSP6
PUTR2

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Throughout the northern and central Rocky Mountains in MT, central ID and northeastern WA. In ID, the distribution of this BpS is limited to lower slope positions in the Boise, Payette and Salmon River drainages. In northeastern WA, it is found on sites <4500ft, particularly along the Columbia and Kettle Rivers and in the Okanogan Highlands.

Biophysical Site Description
These stands typically occurred on hot, dry, south and west-facing slopes at lower elevations with well drained soils and gentle to moderately steep slopes.

Vegetation Description
Frequent fires promoted a grass-dominated understory with sparse shrubs and a ponderosa pine overstory. Douglas-fir and Rocky Mountain juniper may occur as incidental individuals, but overall Douglas-fir cover will be <10%.

Common snowberry, antelope bitterbrush and chokecherry are important shrubs, and mountain mahogany may also occur on rocky outcrops. Grasses may include Idaho and rough fescue (Fischer and Bradley 1987). More mesic shrubs may be present if it is a wetter habitat type that historically maintained an open stand via frequent fire.

Fischer and Bradley (1987), Fischer and Clayton (1983) and Smith and Fischer (1997) would characterize this BpS as predominantly Fire Groups 2 and 4 for western MT and central ID, Fire Group 3 for eastern

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MT and WY, and Fire Group 1 for northern ID. Also refer to Crane and Fischer (1986).

Disturbance Description

Frequent, non-lethal surface fires were the dominant disturbance factor, occurring every 3-30yrs (Arno and Petersen 1993, Arno 1976, Fischer and Bradley 1987). Three-year fire return intervals are likely very localized and associated with Native American burning. However, there is some disagreement as to the extent of Native burning. Median fire return intervals were likely about 15yrs. Mixed-severity fires likely occurred about every 50yrs, depending on the vegetative state. Stand-replacement fires likely occurred in stands and small patches on the order of a few hundred acres every 300-700yrs also depending on the vegetative state. Some authors note that little information is available regarding the exact nature of stand replacement fire severity in this BpS.

Western pine beetle can attack large ponderosa pine in any canopy density.

Adjacency or Identification Concerns

Vegetation is characterized by Pfister et al. (1977) as the ponderosa pine series, by Steele et al. (1981) as the ponderosa pine series and by Williams et al. (1995) as Douglas-fir-ponderosa pine.

These sites typically formed the lower timberline in the area and were historically found adjacent to grasslands and shrublands that dominated valley bottoms. The early seral stages often resemble adjacent shrubland or grassland BpS.

In the 21st century, after missing several fire return intervals, these stands may support an overabundance of stagnant ponderosa pine pole thickets, heavy duff and litter layers and few grasses or shrubs. As a result it may be difficult to distinguish this BpS in its mid and late seral stages from BpS 1045.

Dense pockets of Douglas-fir may also occur. This BpS may be found on several different habitat types depending on the local fire regime; FRG I maintained these stands as ponderosa pine, but today they may be supporting Douglas-fir in some areas.

This vegetation type continues to be commercially logged. Site modifications include plantations and terraces.

Native Uncharacteristic Conditions

Cover >60% can be considered uncharacteristic in this woodland community.

Scale Description

Stands dominated by ponderosa pine with frequent fire return intervals commonly exhibit very small patch sizes even though fire events occurred over hundreds or thousands of acres (Agee 1998). Open, late-seral stands typically dominated the landscape with frequent fire, though even-aged stands were uncommon. In ID, this type was often found as a narrow band between grassland/shrublands at lower elevations and Douglas-fir types at higher elevations.

Issues/Problems

1) Fischer and Bradley (1987) show only a single pathway from the dense pole stage characterized by succession without a fire disturbance (class A to class B). However, it seems that under a frequent fire regime, these stands would typically bypass class B and move directly to class C--unless there is not enough fuel to carry fire at this stage; insufficient stand density and leaf litter. 2) Mixed-severity and stand-replacement fire return intervals are not well documented in the literature for this BpS. Some evidence suggests these fires indeed occurred, but there may be room to improve the assumptions used in this

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modeling effort. 3) There was some debate in the in-workshop peer review over the probability of mixed fire. Currently the model shows a fire interval of about 70yrs for mixed severity fire; some thought it should be more like 50yrs.

The southern portion of MZ10 may have supported a more frequent fire regime and thus more of class D. The BpS was not split for MZ10.

Comments

For MZ20, this BpS was adopted as-is by MFSL from MZ19.

For MZ19 - Additional reviewers were Steve Barrett (sbarrett@mtdig.net), Susan Miller (smiller03@fs.fed.us), Lyn Morelan (lmorelan@fs.fed.us), Catherine Phillips (cgphillips@fs.fed.us) and Cathy Stewart (cstewart@fs.fed.us). Peer review resulted in additions to the description.

This model was adapted from the Rapid Assessment model R0PIPOnr by Tonja Opperman and Lynnette Morelean and reviewed by Steve Barrett, Cathy Stewart and Jane Kapler-Smith.

This model was imported from Z19 by Brendan Ward.

Vegetation Classes

Class A 5%

Early Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Description

Indicator Species* and Canopy Position

FEID	Lower
PSSP6	Lower
PIPO	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	60 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Grass species are the dominant lifeform in this class attaining maximum heights of three feet and being patchy in distribution (25-75% cover).

Fire-maintained grass/forb and/or seedlings and saplings. Seedling/sapling size class would be less than five inches in diameter. There would be no large patches (10-100ac) of large or old-growth trees due to poor site conditions and abundance of rock outcroppings. However, dispersed large diameter fire remnant ponderosa pines with snag trees could be present. These large diameter trees would have a density of less than one tree per acre.

Class B 10%

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Description

Indicator Species* and Canopy Position

PIPO	Upper
FEID	Lower
PSSP6	Lower
PSME	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	60 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

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**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.

Closed PIPO pole and medium stand; may have Douglas-fir as incidentals. Larger, old-growth trees may be present in this class, the pole and medium diameter class (5-21in) occurring between these large trees is most abundant and characteristic of this class. May see large diameter snags, dead and down trees present. High density stunted pole stands are counted here; may see insect/disease here.

Class C 20 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper
FEID	Lower
PSSP6	Lower
PSME	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	40 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Open PIPO pole and medium stand that may have Douglas-fir as incidentals. Larger, old-growth trees may be present in this class, the pole and medium (5-21in) diameter trees are representative of this class. These patches have probably had recent fire or are drier and therefore retain a more open condition.

Class D 55 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper
FEID	Lower
PSSP6	Lower
PSME	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	40 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Fire-maintained open, park-like PIPO; nearly any fire maintains; Douglas-fir may be seen as incidentals or in patches, but not a major component of the overstory. The overstory is characterized by large and very large ponderosa pine and isolated Douglas-fir. Understory is dominated by grasses and is relatively open. Seedlings are very infrequent, with <10% cover usually occurring in patches.

Class E 10 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 10

Indicator Species* and Canopy Position

PIPO	All
PSME	All

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	60 %
Height	Tree 10.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

High density, multi-storied PIPO stand; Douglas-fir regeneration on some sites. Thickets of various size classes distributed within the class and may be interspersed with large snags.

Disturbances

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Fire Regime Group:** I

Historical Fire Size (acres)

Avg 0
Min 0
Max 0

Sources of Fire Regime Data

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

Additional Disturbances Modeled

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

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	360	50	1000	0.00278	4
Mixed	55	16	100	0.01818	24
Surface	18	12	20	0.05556	73
All Fires	13			0.07652	

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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010540 Southern Rocky Mountain Ponderosa Pine Woodland

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

General Information

Contributors (also see the Comments field) **Date** 2/16/2006

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Vegetation Type
Forest and Woodland

Map Zone
20

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

Dominant Species*
PIPO
PASM

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
This BpS is located in southeastern MT, the Missouri River Breaks of northern MT and in MT in on Rocky Mountain Front. It occurs throughout all sections of MZ20. It probably also occurs through to MZ29.

Biophysical Site Description
The geology is typically sedimentary in origin. Often found extending from mountain foothills and plains, but can also be found on buttes, hogbacks, rocky outcrops, and steep, rocky slopes.

Elevations range from approximately 2,500 to 4,500 feet. It occurs at 2500-4000ft on southerly aspects and 3500-4000ft on northerly aspects.

In MZ20, the Missouri Breaks sites described by this BpS are located on southerly aspects, or on upper edges of coulees (more gentle slopes, or above 3400ft elevation. (The remainder of the Breaks is modeled under 201045PP, which covers northerly aspects that are generally steep, and sites below 3400ft elevation.)

Vegetation Description
This type is dominated by ponderosa pine and is often the only tree present.

Understory composition varies but Rocky Mountain Juniper, skunkbush sumac, mountain mahogany, snowberry, yucca and rosa are common woody species. Currant and chokecherry are found in the MT portion of the range. In the Missouri Breaks at elevations above 3400ft, horizontal juniper can dominate the understory. This may also be an association with Neldore soils.

Northerly aspects of the Breaks where Douglas-fir co-dominates or dominates the canopy, are NOT

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included in this model and are instead in 1045 ponderosa pine.

Herbaceous species include needlegrasses, gramma grasses, little bluestem, threadleaf sedge and western wheatgrass. In the southeastern portion of MT, sunsedge and buffalograss are significant components.

Disturbance Description

Generally frequent fires of low severity (Fire Regime Group I or III). Mixed severity fire occurs in the closed canopy conditions with a frequency of between 20-150yrs, and stand replacement fire is very infrequent (300yrs+). Surface fires are frequent and range from <10yrs to more than 20yrs (Barrett 2004; Brown and Sieg 1999, Fisher et al. 1987).

The majority of RA review agreed with the original model's parameters for mixed fire, but thought surface fire could be slightly less frequent. One review contended that there is no evidence of mixed severity fire in this type at all, and that the overall MFI should be around 25yrs. As a compromise, surface fires were reduced in frequency. Mixed severity fire was left in the model based on in-workshop and post-workshop review. These changes resulted in a higher MFI and an increase in the amount of the landscape in the mid- and late-development open classes

Variation in precipitation and temperature interacting with fire and ungulate grazing affects pine regeneration. Windthrow, storm damage and mountain pine beetles were minor disturbances in this type unless stands reach high densities. The interactions between drought, insects and disease are not well understood.

Adjacency or Identification Concerns

This type is surrounded by Northwestern Great Plains Mixedgrass Prairie and the dominant sagebrush system. At the upper elevation, it transitions into 2010452 Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest-Ponderosa Pine.

Ponderosa pine in this BpS has encroached into the mixedgrass prairie type in many areas due to fire suppression and grazing. Tree density has greatly increased today.

This BpS is intermingled within the 1045 ponderosa pine split in MZ20 which models the relatively cooler and more mesic sites in the Missouri Breaks. This BpS 1054 models the warmer, dryer sites in the Breaks. In MZ20, the Missouri Breaks sites described by this BpS are located on southerly aspects, or on upper edges of coulees (more gentle slopes, or above 3400ft elevation. (The remainder of the Breaks is modeled under 201045PP, which covers northerly aspects that are generally steep, and sites below 3400ft elevation.)

Native Uncharacteristic Conditions

Scale Description

Patch size probably ranged from 10s to 1000s of acres.

Issues/Problems

Comments

Model for MZ20 was adopted from R0PIPOnp by Breck Hudson. Only minor descriptive changes were made. Other reviewer for MZ20 was LaWen Hollingsworth (lhollingsworth@fs.fed.us).

For the Rapid Assessment, the workshop code was PPIN11.

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Additional authors for the Rapid Assessment included Deanna Reyher, Carolyn Sieg, Breck Hudson, Cody Wienk, Peter Brown and Blaine Cook. This type was modeled based on earlier work done by an expert panel (Morgan and Parsons 2001). Collapsing of stages were necessary to fit the five-box model used for this process.

Rapid Assessment peer review incorporated on 4/18/05. Reviewers were Bill Baker, Dennis Knight and Brad Sauer. Peer review comments disagreed on the role of mixed and surface fire in this type.

Vegetation Classes

Class A 10%

Early Development 1 All Structures

Upper Layer Lifeform

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

Fuel Model

Description

Indicator Species* and Canopy Position

NAVI	Upper
PASM	Upper
ROSA	Upper
SYMPH	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Herb 0m	Herb 0.5m
Tree Size Class	no data	

[x] Upper layer lifeform differs from dominant lifeform.

Both shrubs and herbaceous are the upper layer lifeform - approximately same height in this class.

This community is dominated by herbaceous and woody species, including the graminoids needlegrasses, western wheatgrass and little bluestem in moister areas, and various shrubs including skunkbush and snowberry. Ponderosa pine seedlings are scattered and found in small clumps.

Number of years in this class is variable depending on climatic patterns and fire disturbances. Succession was modeled at 30yrs, which takes this class to a mid-open stage. In the absence of fire for 25yrs, this class will move to a mid-closed stage.

Mixed fire occurs every 20yrs, low severity every 30yrs and replacement fire every 50yrs.

Class B 5%

Mid Development 1 Closed

Upper Layer Lifeform

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

Fuel Model

Description

Indicator Species* and Canopy Position

PIPO	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	100 %
Height	Tree 0m	Tree 5m
Tree Size Class	Pole 5-9" DBH	

[ ] Upper layer lifeform differs from dominant lifeform.

Multi-story stand of small and medium trees with saplings and seedlings coming in as clumps. Understory is sparse.

This stage lasts for a little over 100yrs, and then it moves to a late closed stage.

Tree height goes from 0.5-5m.

Insects/disease (beetles) occur every 50yrs (0.02 probability or 2% of the landscape each year), maintaining the

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class in this stage.

Mixed fire occurs every 15yrs, causing a transition to a mid-open stage. Low-severity fires occur every 200yrs maintaining this stage. Replacement fires occur every 50yrs.

Class C **15 %**

Mid Development 1 Open

Indicator Species* and Canopy Position

PIPO Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	50 %
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model

Description

Generally single story stands with a few pockets of regeneration. Low shrubs such as snowberry and skunkbush are present as well as grass and forbs. Rocky Mountain juniper present in patches.

Trees might be taller in this class than in class B, because they're not overstocked. Height goes from 0.5-10m.

This class lasts for approximately 70yrs, and then it moves to a late-open stage. In the absence of fire for 40yrs, this class moves to a mid-closed stage.

Mixed fire occurs every 160yrs, and low-severity fire every 15yrs, both maintaining the class in this stage. Replacement fire occurs every 650yrs.

Class D **65 %**

Late Development 1 Open

Indicator Species* and Canopy Position

PIPO Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	50 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model

Description

Generally single story stands of large ponderosa pine with pockets of smaller size classes (replacement). Snowberry, skunkbush, patches of Rocky Mountain juniper and grasses are still present.

This class will persist. However, in the absence of fire for 40yrs, it will go to a late-closed stage.

Insect/disease occur every 50yrs (0.02 probability or 2% of the landscape each year), maintaining the class.

Mixed severity fires occur every 160yrs, and low severity fires every 15yrs, both maintaining this stage. Replacement fires occur every 650yrs.

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Class E **5%**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	100 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Multi-story stands of large, medium, small and seedling ponderosa pine. Shrubs and grasses are sparse. This type generally exceeds 70% canopy cover.

Because this class is dense, the max tree size class is smaller. Maximum DBH is probably approximately 15in.

Insect/disease occur approximately every 250yrs (0.004 probability or .4% of the landscape), and wind/weather/stress every 500yrs (0.002 probability of .2% of the landscape each year), bringing the class to a late-open stage.

Mixed fire occurs every 15yrs, causing a transition to a late open stage. Low-severity fire occurs every 200yrs, maintaining this stage. Replacement fire occurs every 50yrs.

Disturbances

Fire Regime Group:** I

Historical Fire Size (acres)

Avg

Min

Max

Sources of Fire Regime Data

- ☑ Literature
- ☑ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	300			0.00333	5
Mixed	75			0.01333	20
Surface	20			0.05	75
All Fires	15			0.06667	

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

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010550 Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland

☑ *This BPS is lumped with: 1050*

☐ *This BPS is split into multiple models: 1050 and 1055 are lumped/identical. 1050 is seral to 1055 and should probably be dropped for this zone.*

General Information

Contributors (also see the Comments field) **Date** 6/13/2006

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Modeler 2			**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type

Forest and Woodland

Map Zone

20

Model Zone

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

Dominant Species*

PICO	ARCO9
VASC	MARE11
ABLA	CAGE2
PIEN	

General Model Sources

☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

The Rocky Mountain Lodgepole Pine Forest BpS (1050) and 1055 occurs throughout MZ21, including west-central WY, ranging from the eastern flanks of the Wind River Range west to the Bridger-Teton National Forest, north to the Gallatin Range, and west towards Island Park, ID. It encompasses mid and upper elevations of the Bridger-Teton National Forest and portions of the Caribou Targhee in this mapzone. It is also found in subsections highlands M331Dm, M331Dd, M331Aa and M331Ae.

For MZ20, lower subalpine lodgepole pine is quite common (Pfister et al 1977).

Biophysical Site Description

Subalpine cold climate, dry-mesic but usually comes in the winter months as snow, except at the eastern flanks of the Wind River Range where the majority of the precipitation occurs in the spring months. Soils are usually excessively well-drained, residual or glacial till and alluvium on valley floors, droughty moderately deep to deep soils over fractured granodiorite, quartzite and sandstone bedrock. Coarse fraction 30-50% in soil, soils moderately deep to deep to broken rock or bedrock. Soils are acidic, and rarely formed from calcareous parent materials. Biophysical Setting 1050 occurs regularly and conspiciously on the Flathead Sandstone Formation along the entire eastern Flank of the Wind River Range. Precipitation 400-900 mm/yr.

Vegetation Description

These forests are dominated by Pinus contorta, ABLA, PICEA, with shrub and grass. Sometimes there are intermingled mixed conifer/Populus tremuloides stands with the latter occurring with inclusions of deeper, typically fine-textured soils. The shrub stratum may be conspicuous to absent; common species include Arctostaphylos uva-ursi, Ceanothus velutinus, Mahonia repens, Spiraea betulifolia, Spiraea douglasii,

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Shepherdia canadensis, Vaccinium spp, Symphoricarpos oreophilus, Ribes viscossissimum, Sambucus cerulea, Pachistima myrinsites, Salix scouleriama and Prunus virginiana. Grasses include Elymus glauccus, Poa wheeleri, Carex rossii, Carex geyeri and Carex hoodii. Dominant forbs are Arnica cordifolia and Hieracium alboflorum.

Disturbance Description

These are subalpine forests where the dominance of Pinus contorta is related to fire history and topo-edaphic conditions. Following stand-replacing fires, Pinus contorta will rapidly colonize and develop into dense, even-aged stands depending on site characteristics and cone serotiny. In areas with low serotiny, the stands will be less dense and gradually seed in versus develop even-aged stands immediately. The mean FRI is variable depending on such factors as terrain, elevation, precipitation, and temperature and often is influenced by neighboring fire regimes in more frequently burned adjacent forests and grasslands (ie, "contagion" effect).

For MZ20, the range is thought to be between 40-300yrs, with an overall MFI of 100yrs split between 70% stand replacing and 30% mixed severity fire regime.

At approximately 80-100yrs of age, insect, disease and/or blow down create small openings in forest canopy maintaining class B. Under favorable (extreme, 95% percentile) weather, early successional stands will burn where live herbaceous fuel load is sufficient to carry fire. Wind/weather events were not modeled.

Fire size is largely dependent on climatic conditions. During periods when summers are rarely dry, average fire size is about 100ac but when dry summers and fast-moving cold fronts occur, fire sizes can range from 1000-100000ac.

Fire frequency less than 300yrs will keep lodgepole pine on the landscape.

According to Fisher and Clayton (1983), fire return intervals at elevations >7500ft average 150yrs, but range from 300-400yrs in Yellowstone. In areas at <7500ft, fire return intervals vary from 100-500yrs with some recurring cool fires that thin stands without serious damage for this type (Novak, personal correspondence). However, Barrett's (2004) summary of data from all fire history plots in the Northern Rockies as of 2000 suggests widely ranging MFIs for lodgepole pine forests east of the Continental Divide. That is, presettlement MFIs were as frequent as every 30yrs between mixed severity fires (relatively dry lower elevation environments), to infrequent stand replacement fires (up to 300yrs in relatively cold-moist upper elevation terrain).

Adjacency or Identification Concerns

1050 is not a BpS in MZ21 but is a seral component of this BpS. This type was modified from 1810500 by adding class D, the spruce/fir climax that would occur without fire.

This should be distinguished from 1056, as 1056 is moister. Many of the tree species are similar, but shrub component is distinct. Reviewers for MZ20 were considering lumping this system with 1056, but decided not to based on moisture gradient and different shrub component.

BpS 1055 is also slightly lower in elevation than 1056.

Lodgepole pine stands in the montane and lower subalpine zones, that are on less well-drained soils, are usually seral to mixed conifer or subalpine BpS, including species such as Douglas-fir, Engelmann spruce, whitebark pine and subalpine fir. Some Pinus contorta forests will persist on sites that are too extreme (hot

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and dry) for other conifers to establish (BpS 1167). Persistent PICO is also found in frost pockets (reviewers, MZ21).

Currently, balsam bark beetle is killing subalpine fir trees throughout the Rocky Mountain subalpine mesic spruce fir region.

This type is a subalpine forest, as opposed to the mixed conifer montane model of BpS 2010451.

Native Uncharacteristic Conditions

Scale Description

The Rocky Mountain Lodgepole Pine Forest occurs in large (100-1000s of acres) tracts often times following patterns of bedrock and/or surficial geology. The scale of disturbance is generally large, ranging from 100-1000s of acres. Microclimate may have significant influence on the patch size and mosaic of the disturbance.

Issues/Problems

BpS 1050 Rocky Mountain Lodgepole Pine Forest is a successional stage of BpS 1055 Rocky Mountain Dry Mesic Dry-Spruce-Fir Forest and Woodland. Fire frequency at <300yrs will keep lodgepole pine on the landscape.

The model for MZ20 was changed from the MZ21 model to reflect a different understanding of this system in this mapzone; therefore, FRIs and percentages in classes vary from MZ21 due to differing opinions about this system. The MZ21 model is focused on a Greater Yellowstone Ecosystem view, whereas this MZ20 model is not.

Comments

This model for MZ20 was adapted from the same BpS in MZ21 created by Don Despain, Aaron Wells and Vicky Edwards and reviewed by Bil Romme, Liz Davy and Tim Belton. The model for MZ20 was changed to reflect a different understanding of this system in this mapzone; therefore, FRIs and percentages in classes vary from MZ21 due to differing opinions about this system. The MZ21 model is focused on a Greater Yellowstone Ecosystem view, whereas this MZ20 model is not.

This model for MZ21 is based on the LANDFIRE model for BpS 1050 from MZ18 created by Sarah Heide (sarah_heide@blm.gov) and reviewed by Louis Provencher (lprovencher@tnc.org). This type for MZ21 was modified from 1810500 by adding class D, the spruce/fir climax that would occur without fire. Model for MZ21 was further reviewed by an anonymous reviewer in February and Heidi Whitlatch (hwhitlatch@fs.fed.us), David Barron (dbarron@fs.fed.us), Spencer Johnston (sjohnston@fs.fed.us), Candi Eighme (ceighme@fs.fed.us) and Lisa Heiser (lheiser@fs.fed.us).

Vegetation Classes

Class A **15%**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Indicator Species* and Canopy Position

VASC	Lower
RIVI	Lower
CAGE2	Lower
PICO	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0%	100%
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

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Description

Grasses, forbs, low shrubs and lodgepole seedlings-saplings. Succeeds to B after 20yrs because young lodgepole grows fast. If aspen is present, it grows faster and dominates lodgepole during this stage only. Cover of trees (seedlings-saplings) varies widely. This could be considered a grass stage unless there is a lodgepole seed source nearby (MZ21 reviewers).

Replacement fire occurs every 100yrs on average, setting back succession to age zero.

Class B **35 %**

Mid Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PICO	Upper
VASC	Lower
CAGE2	Lower
ABLA	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Moderate to dense pole-sized trees, sometimes very dense (dog-hair). Closed canopy is 51-100%. Mid-open stands are at 21-50% canopy cover and would have mature and immature aspen present. Mid-open stands would have subalpine fir in the understory. Therefore, this class is considered a mid-development all-structures class.

Class will last until 80yrs and then succeed to C. Insects and disease (mean return interval of 75yrs) maintain class B. Competition may maintain the dog-hair condition (prob/yr = 1/500).

Fire was modeled with an overall FRI of 100yrs, split between 70% replacement fire and 30% mixed fire maintaining this stage.

Class C **20 %**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 10

Indicator Species* and Canopy Position

PICO	Upper
ABLA	Mid-Upper
VASC	Lower
CAGE2	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Many mature lodgepole pine, somewhat patchy, variety of lodgepole size classes, open canopies overall but patches of denser trees. This class lasts until 350yrs, then succeeds to the spruce/fir class (class D). There is also a possibility that this transition could occur sooner, thus an alternative succession pathway was modeled at .01.

Insects rarely kill all, and they would instead cause a transition to class B (0.006 probability) or maintain it in C (0.006 probability).

Fire was modeled with an overall FRI of 100yrs, split between 70% replacement fire and 30% mixed fire bringing this stage back to B.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Class D 30 %

Late Development 2 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 10

Indicator Species* and Canopy Position

ABLA	Upper
PIEN	Upper
VAME	Lower
VASC	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	100 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Mature spruce/fir forest with a variety of size classes from seedling to mature. Insect and disease usually affects only one species so survivors trees of other species remain in the stand.

This class is distinguished from C by species, not canopy closure or tree height.

Reviewers state that spruce beetle could kill most of the spruce and transition this class back to class A. However, this scenario was not modeled.

Fire was modeled with an overall FRI of 100yrs, split between 70% replacement fire and 30% mixed fire maintaining this stage.

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:** III

Historical Fire Size (acres)

Avg 1000
Min 10
Max 100000

Sources of Fire Regime Data

- ☑ Literature
- ☑ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	135	90	350	0.00741	74
Mixed	385			0.0026	26
Surface					
All Fires	100			0.01001	

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

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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LANDFIRE Biophysical Setting Model

Biophysical Setting: **2010560** **Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland**

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

General Information

Contributors (also see the Comments field) **Date** 6/16/2006

Modeler 1	Steve Barrett	sbarrett@mtdig.net	**Reviewer**	Cathy Stewart	cstewart@fs.fed.us
Modeler 2			**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type
Forest and Woodland

Map Zone
20

Model Zone

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

Dominant Species*
PIEN
ABLA
PICO

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Northern Rockies, including MT, ID and WY. This BpS is thought to be very limited in extent in MZ20.

Biophysical Site Description
Upper subalpine zone and mesic sites. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines. They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs; northerly and easterly aspects predominate. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateau-like surfaces, basins, alluvial terraces, well-drained benches and inactive stream terraces. Reviewers for MZ20 felt that the preceeding sentence does not align with this BpSs shrub understory component, as this BpS has moist-driven shrubs and may occur near riparian areas.

Vegetation Description
Engelmann spruce and subalpine fir dominate on most aspects with lodgepole pine comprising a greater component on dryer sites or earlier successional stages. Early succesional vegetation contains Eurybia conspicua and Carex geyeri. Vaccinium scoparium is a common understory associate in later successional stages.

Mesic understory shrubs include Menziesia ferruginea, Vaccinium membranaceum, Rubus parviflorus and Ledum glandulosum. Herbaceous species include Actaea rubra, Maianthemum stellatum, Cornus canadensis, Erigeron engelmannii, Saxifraga bronchialis, Lupinus argenteus ssp.subalpinus, Valeriana sitchensis and graminoids such as Carex generii and Calamagrostis canadensis.

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**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.

Disturbance Description

Fire Regime Group V or IV; primarily long-interval stand replacement fires. In some areas, spruce beetle can influence successional stage, species composition and stand density. Spruce beetle may act to accelerate succession.

For MZ21, all modelers and reviewers agreed that this fire return interval should be greater than 300yrs. Most of the fire is modeled as replacement fire. There might be some mixed severity fire in this system, and it is modeled in the late closed state, as per modelers and reviewers.

For MZ20, overall MFI would not be greater than 200yrs. Unlike in central WY and CO and Greater Yellowstone Ecosystem, the overall MFI should be no more than 200yrs for MZ20 spruce-fir stands, because this relatively minor BpS is heavily affected by contagion (ie, reflects the influence from more-frequent fire regimes that dominate the neighborhood).

Adjacency or Identification Concerns

Adjacent to drier, lower subalpine forests (lodgepole-spruce-fir) and to krummholz and alpine vegetation. This system typically has more precipitation and longer winters than lower subalpine types.

Climate (severely dry conditions) is the primary driver of fire regimes in this system. Long-term changes in climate as well as interannual climate variability will affect the frequency of fire in this system.

This BpS corresponds to the following habitat types (Pfister et al. 1977): ABLA/ALSI, ABLA/CAGE, ABLA/VASC, TSME/XETE, TSME/MEFE, TSME/CLUN, PICEA/GART, PICEA/LIBO and PICEA/PHMA.

Currently, balsam bark beetle is killing subalpine fir trees throughout the Rocky Mountain subalpine mesic spruce fir region.

Native Uncharacteristic Conditions

Scale Description

Fires could range from 1000s to 10000s of acres. Variability of climate, topography and other site factors can result in a wide range of representation of successional stages on the landscape. Equilibrium landscapes are not likely to develop in areas <500000ac, or perhaps not in areas greater than that either (Romme, personal correspondence). Reviewers state that typical fires in this system are small clumps of stand replacing fires with spots to adjacent clumps. However, when this BpS is viewed in context within a larger landscape with the surrounding lodgepole pine BpS (as is the case in MZ20), large and uniform replacement fires are more typical.

Issues/Problems

Reviewers state that since 1990, mortality in the subalpine fir complex has increased.

Comments

This model for MZ20 was adapted from the model from the same BpS from MZ21, created by Vicky Edwards (vedwards@fs.fed.us), Tim Brickell (tbrickell@fs.fed.us) and Don Despain (don_despain@usgs.gov) and reviewed by Liz Davy, Tim Belton, Bill Romme. The model for MZ20 was changed to reflect differences in this system in this mapzone; therefore, FRIs and percentages in classes vary from MZ21. The MZ21 model is focused on a Greater Yellowstone Ecosystem view, whereas this MZ20 model is not. See Disturbance Description for further info.

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This model for MZ21 was adapted from LANDFIRE models for the same BpS 1056 in MZs 10 and 19 created by Kathy Roche (kroche@fs.fed.us) and reviewed by Steve Barrett and Cathy Stewart. Descriptive changes to model for MZ21 were made by Vicky Edwards, Don Despain and Tim Brickell. Model was reviewed then by Bill Romme on 1/30/06 and an anonymous reviewer in February 06. Quantitative changes were implemented during the review process in March 06 by Liz Davy, Tim Belton, Heidi Whitlatch, David Barron, Spencer Johnston, Candi Eighme and Lisa Heiser.

The model for MZs 10 and 19 was adapted from the Rapid Assessment model R0SPFI, which was reviewed by Bill Baker (bakerwl@uwyo.edu), Dennis Knight (dhknight@uwyo.edu) and Bill Romme (romme@cnr.colostate.edu). Based on input for MZs 10 and 19 (Steve Barrett, sbarrett@mtdig.net; and Cathy Stewart, cstewart@fs.fed.us), minor modifications were made to the description and mean fire return interval.

Vegetation Classes

Class A 15%

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Indicator Species* and Canopy Position

PIEN	Upper
PICO	Upper
ABLA	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

This is an early succession stage after long interval replacement fires. There can be extended periods (as long as 300yrs) of grass/seedling stage after fire replacement events.

This stage may occupy 3-50% of the landscape depending upon climatic conditions and variability of fire return intervals.

This class succeeds to a mid-development closed state after 40yrs. This class might also succeed to class C, a mid-development open state with a probability of 0.001.

Replacement fire occurs every 200yrs.

Class B 30%

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PIEN	Upper
PICO	Upper
ABLA	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Shade tolerant- and mixed conifer saplings to poles (>60% canopy cover).

High density saplings to poles. May occupy 5-50% of the landscape.

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This class succeeds to a late-development closed state, class E, after 110yrs.

Replacement fire occurs every 200yrs.

Wind/weather/stress occurs with a probability of 0.001 and can take the class to a mid-open state, class C.

It is thought that the reference condition state for this BpS would be dominated by these closed stages, maybe reaching 80% of the landscape - even though 65% is modeled here.

Class C **5%**

Mid Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIEN	Upper
PICO	Upper
ABLA	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	40%
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Low density saplings to poles. Primarily occurs after weather stress thins denser stands, and also from succession from A. It might be possible that this could occur from insects and disease.

This class succeeds to a late-development, open state, class D, after 110yrs.

Replacement fire occurs every 200yrs.

Class D **15%**

Late Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 10

Indicator Species* and Canopy Position

PIEN	Upper
ABLA	Upper
PICO	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11%	50%
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Poles (5in+ DBH) and larger diameter moderately shade tolerant conifer species (<50% canopy cover) in small to moderate size patches. Patches would include subalpine fir seedlings.

This stage occupies 15-50% of the landscape.

Replacement fire occurs every 200yrs.

Endemic spruce beetle occurs at 200-300 year intervals, setting back succession to C epidemic subalpine fir mortality complex. Another reviewer stated that areas affected by spruce beetle were included in the original field-based fire rotation estimates, simply because beetle-affected areas are commonly also burned. Thus, the rotation estimate for fire is really a combination of fire and beetles; therefore, the disturbance was partitioned between these two disturbance types. Insect/disease was modeled at 0.001 probability.

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**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.

Succession to E, late closed state might occur with a probability of 0.001. Otherwise, this class will persist.

Class E 35 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 10

Indicator Species* and Canopy Position

PIEN	Upper
ABLA	Upper
PICO	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	90 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Pole and larger diameter moderately to shade tolerant conifer species (>50% canopy cover), in moderate to large size patches, all aspects.

Fire was modeled as an overall 200yr interval, with replacement fire occuring 80% of the time, and mixed fire occurring 20% of the time, bringing the class to a late open stage.

Endemic spruce beetle occurs at 200-300yr intervals, setting back succession to C epidemic subalpine fir mortality complex. Another reviewer stated that areas affected by spruce beetle were included in the original field-based fire rotation estimates, simply because beetle-affected areas are commonly also burned. Thus, the rotation estimate for fire is really a combination of fire and beetles; therefore, the disturbance was partitioned between these two disturbance types. Insect/disease was modeled at 0.001 probability.

It is thought that the reference condition state for this BpS would be dominated by these closed stages, maybe reaching 80% of the landscape - even though 65% is modeled here.

Disturbances

Fire Regime Group:** IV

Historical Fire Size (acres)

Avg 0
Min 0
Max 0

Sources of Fire Regime Data

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	210	100	600	0.00476	94
Mixed	3333			0.00030	6
Surface					
All Fires	198			0.00507	

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

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010610 Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland

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

General Information

Contributors (also see the Comments field) **Date** 6/16/2006

Modeler 1 Steve Barrett	sbarrett@mtdig.net	**Reviewer**	
Modeler 2		**Reviewer**	
Modeler 3		**Reviewer**	

Vegetation Type
Forest and Woodland

Map Zone
20

Model Zone

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

Dominant Species*
POTR5 PIFL2
PIEN PICO
ABLA
PSME

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
This ecological system occurs on montane slopes and plateaus in UT, western CO, northern AZ, eastern NV, southern ID and western WY. Elevations range from 1700-2800m (5600-9200ft.).

This BpS is thought to be very limited in extent in MZ20 - less even than pure aspen.

Biophysical Site Description
Description taken from MZ18: Occurrences are typically on gentle to steep slopes on any aspect but are often found on clay-rich soils in intermontane valleys. Soils are derived from alluvium, colluvium and residuum from a variety of parent materials but most typically occur on sedimentary rocks. In the northern portion of MZ18, this system occurs throughout the area on north, northeast and southwest aspects with shallow soils.

Vegetation Description
The tree canopy is composed of a mix of deciduous and coniferous species. The BpS is a matrix of even-aged Populus tremuloides patches interspersed among conifer stands including Abies lasiocarpa, Picea engelmannii, Pinus flexilis, Juniperus occidentalis (southwestern ID) and Pseudotsuga menzesii. As the occurrences age, Populus tremuloides is slowly reduced until the conifer species become dominant.

Common shrubs include Amelanchier alnifolia, Prunus virginiana, Symphoricarpos oreophilus, Juniperus communis, Paxistima myrsinites, Rosa woodsii, Spiraea betulifolia, Symphoricarpos albus or Mahonia repens.

Herbaceous species include Bromus carinatus, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Poa spp, Achnatherum nelsonii, Melica bulbosa and Achnatherum, Hesperostipa, Nassella and/or Piptochaetium

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spp (=Stipa spp.), Achillea millefolium, Arnica cordifolia, Asteraceae spp, Erigeron spp, Galium boreale, Geranium viscosissimum, Lathyrus spp, Lupinus argenteus, Mertensia arizonica, Mertensia lanceolata, Maianthemum stellatum, Osmorhiza berteroi (=Osmorhiza chilensis) and Thalictrum fendleri.

Disturbance Description

This is a strongly fire adapted community, more so than BpS 1011 (Rocky Mountains Aspen Woodland and Forest), with FRIs varying for mixed severity fire with the encroachment of conifers. BpS 1061 has elements of Fire Regime Groups II, III and IV. Mean FRI for replacement fire is every 60yrs on average. Replacement fire is absent during early development (as it is for stable aspen, BpS 1011) and has a mean FRI of 100yrs (between 80-100yrs in the open condition). The FRI of mixed severity fire could increase from stands <100yrs to stands >100yrs with conifer encroachment. Episodic drought and fire could maintain the MFI of 60-100yrs. Fire was modeled with an overall FRI of 50yrs, split between mixed and replacement fire 50/50. However, for class D, the late open stage, fire was split 40/60 mixed/replacement, respectively.

As this type has a fairly short fire return interval compared to other aspen types, it should be noted that aspen can act as a tall shrub. Bradley, et al. (1992) state that Loope & Gruell estimated a fire frequency of 25-100yrs for a Douglas-fir forest with seral aspen in Grand Teton National Park (p39). In the Fontenelle Creek, WY drainage, the mean fire-free interval was estimated to be 40yrs. Fires in this area burned in a mosaic pattern of severities, from stand-replacement to low fires that scarred but did not kill the relatively thin-barked lodgepole pine on the site (p46).

Aspen stands tend to remain dense througtout most of their life-span, hence the open stand description was not used unless it described conifer coverage during initial encroachment. While not dependent upon disturbance to regenerate, aspen was adapted to a diverse array of disturbances.

Under presettlement conditions, disease and insect mortality did not appear to have major effects, however older aspen stands would be susceptible to outbreaks every 200yrs on average. We assumed that 20% of outbreaks resulted in heavy insect/disease stand-replacing events (average return interval 1000yrs), whereas 80% of outbreaks would thin older trees >40yrs (average return interval 250yrs). Older conifers (>100yrs) would experience insect/disease outbreaks every 300yrs on average.

Some sites are prone to snowslides, mudslides and rotational slumping. Flooding may also operate in these systems.

Adjacency or Identification Concerns

If conifers are not present in the landscape, or represent <25% relative cover, the stable aspen model (BpS 1011; Rocky Mountain Aspen Woodland and Forest) should be considered, especially in the southwestern portion of MZ18. If aspen is absent, refer to 1051 or 1052.

This type is more highly threatened by conifer replacement than stable aspen. Most occurrences at present represent a late-seral stage of aspen changing to a pure conifer occurrence. Nearly a hundred years of fire suppression and livestock grazing have converted much of the pure aspen occurrences to the present-day aspen-conifer forest and woodland ecological system.

Under current conditions, herbivory can significantly effect stand succession. Kay (1997, 2001a, b and c) found the impacts of burning on aspen stands were overshadowed by the impacts of herbivory.

Native Uncharacteristic Conditions

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Scale Description

This type occurs in a landscape mosaic from moderate (10ac) to large sized patches (1000ac).

Issues/Problems

In the western Rocky Mountains, Baker (1925) studied closely the presettlement period for aspen and noted fire scars on older trees. Bartos and Campbell (1998) support these findings. We interpreted ground fires that scarred trees, as mixed severity fire that also promoted abundant suckering. In the presence of conifer fuel, these would be killed and aspen suckering promoted.

In previous models from the Rapid Assessment (eg, R2ASMClw), experts and modelers expressed different views about the frequency of all fires, citing FRIs longer than those noted by Baker (1925). The FRIs used here were a compromise between longer FRIs proposed by reviewers and the maximum FRI of Baker (1925).

Comments

This model for MZ20 was adapted from the model from the same BpS in MZ18 created by Krista Waid-Gollnick (krista_waid@blm.gov) and Sarah Heide (sarah_heide@blm.gov) and reviewed by Jon Bates (jon.bates@oregonstate.edu). Descriptive and quantitative changes were made for MZ20 to better match the disturbance description and to abide by mapping rules. The model for MZ18 violated some rules and was not consistent in its output versus description. Descriptive changes were made to better reflect MZ20.

For MZ18, D Major made changes to vegetation class structural values in response to MTDB v3.1 updates (K Pohl 7/18/05 request). BpS 1061 for MZs 12 and 17 was accepted with model and database revisions for MZ18 by K. Waid and S. Heide. Comments by Jon Bates (reviewer) were minor.

BpS 1061 for MZs 12 and 17 was developed by Julia Richardson (jhrichardson@fs.fed.us) and Louis Provencher (lprovencher@tnc.org) and is a compromise among R2ASMClw (aspen-mixed conifers low-mid elevation) from the Rapid Assessment, BpS 1011 for MZs 12 and 17, and BpS 1061 for MZ16. BpS 1061 for MZs 12 and 17 is approximately split into the age classes of R2ASMClw. R2ASMClw was developed by Linda Chappell (lchappell@fs.fed.us), Bob Campbell (rbcampbell@fs.fed.us) and Cheri Howell (chowell02@fs.fed.us), and reviewed by Krista Gollnick-Wade/Sarah Heidi (Krista_Waid@blm.gov), Charles E. Kay (ckay@hass.usu.edu) and Wayne D. Shepperd (wshepperd@fs.fed.us). BpS 1061 for MZ16 was developed by Linda Chappell, Robert Campbell, Stanley Kitchen (skitchen@fs.fed.us), Beth Corbin (ecorbin@fs.fed.us) and Charles Kay.

Vegetation Classes

Class A **10%**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Indicator Species* and Canopy Position

POTR5	Upper
SYOR2	Middle
RIBES	Middle

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	31 %	100 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Grass/forb and aspen suckers <12ft tall. Generally, this is expected to occur 1-3yrs post-disturbance. Fire is absent. Succession to class B after 10yrs.

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Class B 45 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

POTR5	Upper
SYOR2	Low-Mid
RIBES	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Aspen saplings over 12ft tall dominate during the first 30yrs. Aspen trees 5-16in DBH later in the stage, for the last 40yrs. Canopy cover is highly variable. Conifer saplings and seedlings are coming in during the last 40yrs.

This class was originally modeled as two mid-development closed classes; however, in order to abide by mapping/modeling rules, the two mid-closed classes were combined into one. Height was also changed to abide by mapping rules so that it did not overlap with A. So although this class might have trees that are less than five meters, the height chosen for this class is 5.1-10m.

Fire was modeled with an overall FRI of 50yrs, split between mixed and replacement fire; mixed severity fire does not change the successional age of these stands, although this fire consumes litter and woody debris and may stimulate suckering. Mixed severity fire, while thinning some trees, promotes suckering and maintains vegetation in this class.

Insect/diseases outbreaks occur every 200yrs on average with 80% of times causing stand thinning (maintaining this stage - probably bringing it to the earlier years of this stage) and 20% of times causing stand replacement (transition to class A).

Conifer encroachment causes a succession to class C after 70yrs.

Class C 35 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

POTR5	Upper
ABLA	Mid-Upper
PSME	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	50 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Aspen and conifer co-dominate. 60% aspen overstory. Trees can conceivably range in height from 5-25m; however, so as not to have overlap with class B, height was changed to start at 10.1m. Conifers which escape fire, or are the more fire resistant species, will likely cause the progressive suppression of aspen.

Mixed severity fire keeps this stand open, kills young conifers and maintains aspen. Replacement fire is every 100yrs on average. However, fire was modeled with an overall FRI of 50yrs, split between mixed and replacement fire, with 60% mixed fire and 40% replacment fire.

In the absence of any fire for 100yrs, the stand will become closed with conifers (transition to class D).

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Class D 10 %

Late Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PSME	Upper
ABLA	Upper
POTR5	Mid-Upper
PICO	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	80 %
Height	Tree 10.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Conifers dominate at 100yrs+. Aspen over 16in DBH, uneven sizes of mixed conifer and main overstory is conifers. Greater than 50% conifer in the overstory. Trees can conceivably range in height beginning at 5m; however, so as not to have overlap with class B, height was changed to start at 10.1m.

Fire was modeled with an overall FRI of 50yrs, split between mixed and replacement fire. Mixed severity fire causes a transition to class C.

Insect/disease outbreaks will thin older conifers (transition to class C) every 300yrs on average.

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:** III

Historical Fire Size (acres)

Avg 50
Min 1
Max 100

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	115	50	300	0.0087	46
Mixed	100	10	125	0.01	53
Surface					
All Fires	53			0.01871	

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

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**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.

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**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010800 Inter-Mountain Basins Big Sagebrush Shrubland

☑ *This BPS is lumped with: 11250*
☐ *This BPS is split into multiple models:*

General Information

Contributors (also see the Comments field) **Date** 6/5/2006

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Modeler 2			**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type
Upland Shrubland

Map Zone
20

Model Zone

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

Dominant Species*

ARTRW	HECO26
PASM	KOMA
ARCA13	PSSP6
BOGR2	ERNA10

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
Sagebrush occurs throughout much of the west. For MZ19, WY and Basin big sagebrush are found in southwest MT and east-central ID. For MZ20, this BpS is found in most subsections, except in westernmost 331D (most all of the shrubland however should be mapped as 1125 Steppe); however it is a very minor type, especially presettlement. In MZ20, mostly only ARTTSW except in extreme tip of mapzone, where ARTTSV is found at higher elevations.

Occurs where WY Basins ecoregion goes into MT between Beartooth and Pryor Mountains. Also occurs as very small patches particularly where might have pan spots developing.

Biophysical Site Description
This type is found between 3000-7000ft elevation on deep, well drained, alluvial soils in MZs 10 and 19. Artemisia tridentata ssp. tridentata occurs in swales with deeper soils at lower elevations. Artemisia tridentata ssp. wyomingensis is the more common subspecies in MZ19 and occurs on toeslopes and alluvial fans at mid-elevations.

In MZ20, this BpS occurs on fine-textured soils. ARTTSW is found primarily on soils derived from shale and mudstone, ie, on fine-textured substrates; since the landscape is largely plains, landscape features are not particularly good predictors, but geological substrates are. Upper limits more like 5000ft in MZ20. At extreme tip of mapzone, ARTTSV is found at higher elevations.

Vegetation Description
Wyoming and big basin sagebrush subspecies form a mosaic of patches throughout much of this BpS in MZs 10 and 19. Wyoming sagebrush (Atremisia tridentata ssp.wyomingensis) is the dominant species in valley bottoms, alluvial fans.

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In deep soils in MZs 10 and 19, Basin big sagebrush (Artemisia tridentata spp. tridentata) is the dominant subspecies, except on alkaline soils, where greasewood (Sarcobatus vermiculatus) and rabbitbrush (Chrysothamnus spp) may also be present. However, ARTTST (ssp. tridentata) does not occur in MZ20. In MZ19 in SW MT, ARTTSW (ssp. wyomingensis) is a very minor component of the landscape; it is only found in the very lowest elevations squeezed between ARTTSV (ssp. vaseyana) above and ARTTST (ssp. tridentata) below or along drainages. ARTTSW prevails at relatively low cover values (10-30%) with its extent depending on that of the associated geological substrate; the niche filled by ARTTST in other zones is filled by ARTCAN in MZ20.

In MZs 10 and 19, some of the understory grasses include bluebunch wheatgrass (Pseudoroegneria spicata), needle and thread (Hesperostipa comata), squirreltail (Elymus elymoides) and western wheatgrass (Pascopyrum smithii).

In MZ20, as this BpS occurs on fine-textured soils, PASSMI does especially well here. The dominant wheatgrass in MZ20 is PASSMI and it is accompanied by BOUGRA, HESCOM and KOEMAC; the latter two increasing where grazing has been intensive and protracted.

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).

Disturbance Description

Fire regime group IV, but may also encompass III and IV. Fire return intervals are estimated to average approximately 60yrs, and range from 10-150yrs. Although questions have recently been raised about the frequency of fire in this BpS and some adjacent types (Baker 2004 in press), most experts believe that presettlement fire frequency typically was less than 100yrs. Fires were mostly stand replacing (Tirmenstein 1999).

Recovery of ARTTSW sites to preburn ARTTSW density probably takes in excess of 60yrs to possibly 100yrs; thus, if fires were too frequent, hardly any of this BpS would exist, at least in the full sage development stage (Cooper, personal correspondence). For MZ20, there are almost no references for time it takes for sagebrush to return. One study shows no establishment 14yrs post-fire on CMR Refuge. There is also data from SW MT, MZ19 (Lesica and Cooper 2005) to support the notion that full recovery (to that of current control plots) of ARTTSW cover to take approximately 75-100yrs.

It has been hypothesized that prolonged drought has resulted in significant die off in this type.

Insects and disease may have resulted in replacement and mixed-severity disturbances in this type, but little information exists on the frequency of these disturbances under reference conditions. They are not modeled here.

Antelope, mule deer and pygmy rabbits are native herbivores that browse sagebrush. These were also not included in the model.

Adjacency or Identification Concerns

Please note that the only difference between this BpS 1080 and BpS 1125 is in the amount of herbaceous cover. In MZ20, 1080 is by far the more prevalent type, when considering pre-Euro reference conditions.

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BpS 1125 might be more prevalent today in MZ20 due to overgrazing.

It is difficult to distinguish some of these shrubland communities from each other - 1080, 1085 and 1125

Basin big sagebrush grows in association with Wyoming big sagebrush, mountain big sagebrush and desert shrub communities. Distribution is a result of local soil characteristics on a fine scale (1-500ac). Much of this type has been lost due to land clearing for agriculture or converted to a cheatgrass or greasewood type.

In MZ19, ARTTST has been largely lost in MT, but this was more the result of highly productive stream terraces becoming hayfields, not this less productive BpS 1080 (Cooper, personal correspondence).

This BpS will grow in association with Midgrass Prairie and BpS 1125.

Overgrazing has also been an issue. HESCOM and KOEMAC increase where grazing is intense and protracted.

Native Uncharacteristic Conditions

Over 45% shrub cover would be uncharacteristic for MZ20. The only reason it would be this high is in cases of extreme overgrazing.

Scale Description

Disturbance size probably resembles the patch size of the vegetation. With comparatively little fine fuel contributed by herbaceous litter, disturbance (fire) should be discontinuous.

Disturbance patch sizes range from 10s-100s of hectares.

Issues/Problems

It is difficult to map and identify the subspecies of big sagebrushes (Artemesia tridentata) without the aid of field assessments.

Fire size, frequency and severity are variable.

Comments

This model for MZ20 was adapted from the same BpS in MZ19, which was created by Dana Perkins (dana_perkins@blm.gov), Carly Gibson (cgibson@fs.fed.us) and John DiBari (jdibari@email.wcu.edu) and reviewed by Susan Miller, Lois Olsen and Robert Wooley. Descriptive and quantitative changes and adjustments were made to better represent the ecological differences present in MZ20.

The model for MZ19 is based on the Rapid Assessment model R0SBBB by Diane Abendroth (diane_abendroth@nps.gov) and reviewed by Bill Baker (bakerwl@uwyo.edu), Don Bedunah (bedunah@forestry.umt.edu), Shannon Downey (shannon_downey@blm.gov), Karen Clause (karen.clause@wy.usda.gov), Dennis Knight (dhknight@uwyo.edu), Thor Stephenson (thor_stephenson@blm.gov), Curt Yanish (curt_yanish@blm.gov), Gavin Lovell (gavin_lovell@blm.gov) and Eve Warren (eve_warren@blm.gov). Only descriptive changes were made to the model.

Peer review for the Rapid Assessment was incorporated 4/26/2005. There was considerable disagreement among reviewers about how to model this type. All comments were incorporated into the description.

This model was lumped with (subsumed by) the 2011250 model on 11/8/2006 by Brendan Ward at the

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direction of Elena Contreras.

Vegetation Classes

Class A 45 %

Early Development 1 All Structures

Upper Layer Lifeform

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

Fuel Model

Indicator Species* and Canopy Position

PASM	Upper
BOGR2	Upper
HECO26	Upper
KOMA	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.

Shrub cover may be 5-10%.

Description

Grass-dominated community following replacement disturbance. Sagebrush might begin to return within ~ five years, but will remain relatively low canopy cover (<10%). However, it is questionable as to whether it might take more than 14yrs post-fire to have any establishment.

This class lasts up to 40yrs post disturbance and succeeds to mid-development open (class B) unless drought or replacement fire cause stand-replacing disturbance.

Replacement fire occurs every 80yrs, and drought occurs every 100yrs.

Class B 20 %

Mid Development 1 Open

Upper Layer Lifeform

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

Fuel Model

Indicator Species* and Canopy Position

ARCA13	Upper
ARTRW8	Upper
PASM	Lower
BOGR	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	20 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

It probably takes about 40-50yrs to reach this stage, which probably lasts 30yrs or more. The class in this model succeeds to the late development stage after 30yrs.

Sagebrush dominated (up to 15% canopy cover), open shrub community with abundant grasses.

Replacement fire (every 80yrs) or drought (every 100yrs); drought does not cause a transition.

Class C 35 %

Late Development 1 Open

Upper Layer Lifeform

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

Fuel Model

Indicator Species* and Canopy Position

ARCA13	Upper
ARTRW	Upper
PASM	Upper
BOGR	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

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Mature and overmature sagebrush with suppressed understory. Cover minimum would be about 15% and the maximum about 25% for MZ20. In SW MT, there has never been more than 45% sage cover even in ARTTSV vegetation types, unless there were extreme cases of overgrazing.

This condition begins at age 70 and can perpetuate until disturbance causes a transition to another class.

Replacement fire (every 80yrs) and drought (every 100yrs); drought does not cause a transition.

Class D **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Class E **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Disturbances

Fire Regime Group:** **IV**

Historical Fire Size (acres)

Avg 0
Min 0
Max 0

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	80	10	150	0.0125	100
Mixed					
Surface					
All Fires	80			0.01252	

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

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**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.

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2010850 Northwestern Great Plains Shrubland

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

General Information

Contributors (also see the Comments field) **Date** 11/1/2006

Modeler 1	Jeff DiBenedetto	jdibenedetto@fs.fed.us	**Reviewer**
Modeler 2			**Reviewer**
Modeler 3			**Reviewer**

Vegetation Type

Upland Savannah/Shrub Steppe

Map Zone

20

Model Zone

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

Dominant Species*

SYOC	RHTR
JUHO2	SCSC
SHAR	PASM
PRVI	CAFI

General Model Sources

☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

This type should be confined to ephemeral drainages, mesic sites and north facing slopes within mountain ranges and hillsides around the Little Rockies in MZ20. Found in northeastern and southeastern MT, western ND and SD, northeastern WY and western NE. This ecological system ranges from SD into southern Canada on moderately shallow to deep, fine to sandy loam soils. In MZ30, this would occur in section 331.

Biophysical Site Description

Occur as small patches within northern mixedgrass prairie occupying microsites associated with higher available moisture or moderately steep slopes, north and south aspects. Occupies slope shoulders and drainage ways and draws; sites where moisture is more available. Skunkbrush more associated with south aspect slopes. Chokecherry and serviceberry and snowberry associated with drainages and draws. Horizontal juniper associated with north aspect slopes. Buffaloberry associated with north aspect slopes. Each of the shrub species is associated with its own habitat type and moisture gradient. Skunkbrush is in the dry end, and snowberry/chokecherry is in the wet end. Snowberry is also found along seep areas, riparian areas and mountain hillsides. This BpS is capturing a broad moisture regime from dry to mesic.

Elevations range from 1300-4000ft, and up to 4500ft east side of the Judiths, and 5000ft south side of the Snowies. Temperatures range between extremes of hot summers and cold winters that are typical of a continental climate. Precipitation increases from west (11in) to east (16in). Two-thirds of the precipitation occurs during the growing season (April-June).

Soils vary, but are generally entisol in the west and mollisols in the east. Soils in the northern Great Plains, west of the Missouri River in the Dakotas, northwestern NE, northeastern WY and MT are formed from sedimentry sandstone and shales, especially the badlands type topography. These soils range from clayey,

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fine-loamy, to fine silty soils of mixed origin on level and undulating lands with minor contributions from loess, alluvium and mountain outwash.

Many of these shrubland types occur on moderate to steep slopes (west to NW facing) at least in the badlands - grazing is not likely a factor. They occur on southwest and northwest facing slopes and moderate to steep slopes. The skunkbrush however, more associated with the southerly aspects.

These sites are typically more mesic than most of the surrounding area. This system may be located along upper terraces of rivers and streams, gently inclined slopes near breaklands, and upland sandy loam areas throughout its range.

Vegetation Description

This vegetation type is characterized by the dominance of snowberry, chokecherry, serviceberry, skunkbrush, buffaloberry and horizontal juniper. There is an understory of cool-season grasses such as western wheatgrass, needlegrasses, Sandberg bluegrass, little bluestem, threadleaf sedge and forbs.

(Silver sage was also an important component historically; however, silver sage is covered in 1162 Floodplains Systems and 1148 Western Great Plains Sand Prairie. Silver sage associated with valley bottom/terraces along streams and drainageways.)

This melds into 1141 needle and thread/western wheatgrass.

Each of the shrub species in this BpS is associated with its own habitat type and represents a broad moisture gradient from dry to mesic. Skunkbrush is in the dry end, and snowberry/chokecherry and buffaloberry is in the mesic end. All of these species don't occur together necessarily.

Disturbance Description

The northern mixed-grass prairie and shrublands are strongly influenced by wet-dry cycles. Fire, grazing by large ungulates and small mammals such as prairie dogs and soil disturbances (ie, buffalo wallows and prairie dog towns) are the major disturbances in this vegetation type. In MZ30, many of these shrubland types occur on moderate to steep slopes (west to NW facing).

From instrumental weather records, droughts are likely to occur about three in every 10yrs. Historically, there were likely close interactions between fire and grazing since large ungulates tend to be attracted to post-fire communities. Conversely, fire presumably was less likely in areas recently heavily grazed by herbivory - thus contributing to spatial and temporal variation in fire occurrence.

Average fire intervals are estimated at 8-25yrs, although in areas with very broken topography fire intervals may have been greater than 30yrs. The model for MZ20 reflects a 30-year FRI. This system's FRI should be very similar to 1141 mixedgrass prairie, since this system is just inclusions within 1141. It might be a little less frequent because of moisture; however, it should be similar.

Fires were most common in July and August, but probably occurred from about April to September. Seasonality of fires influences vegetation composition. Early season fires (April - May) tend to favor warm-season species, while late season fires (August - September) tend to favor cool-season species. Replacement fire in our model does remove 75% of the above ground cover as assumed in the literature. However, we don't think loss of the above ground cover by the replacement fire will necessarily induce a retrogression back to an earlier seral stage from the late stage because the main component of dominant grasses remains unharmed to insure the continuity of the seral stage. The shrub species, however, are sprouters. Fire would remove them, and they would re-sprout. The exception would be horizontal juniper and skunkbrush which

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would not resprout. It would take longer for them to become re-established.

We used different levels of native ungulate grazing intensities. We assumed that light grazing would not alter the community enough to change classes, but increasing grazing intensity would move the community back to earlier stages. Grazing return interval probably occured every 7-10yrs but grazing would only result in a class change maybe once every 80-100yrs. Overall, the grazing frequency was modeled at every 20yrs - that includes grazing just occuring with no transition resulting, as well as grazing taking the stage back to an earlier class. And, overall, the drought plus grazing impact frequency was modeled as every 70yrs - that includes the no-transition plus transition to early stage.

Ortmann in his review of the RA model, suggested that in addition to fire, drought and grazing and insect outbreaks (Rocky Mountain locust) would have impacted all classes.

Adjacency or Identification Concerns

Inclusions within the mixedgrass prairie. The Northwestern Great Plains Shrubland might be a subcomponent of the Northwestern Great Plains Mixedgrass Prairie BpS that was historically limited to predominantly sedimentary soil types and local microsites; resulting in a similar ecological model, but with a longer fire cycle. This 1085 might therefore be difficult to map differently from the grassland sites. Spectrally, however, this BpS will have a unique signature - esp snowberry. The sites dominated by skunkbrush might be harder to differentiate from the grasses. This melds into needle and thread/western wheatgrass 1141.

Rabbitbrush, may be better to fit with sagebrush BpS. They tend to occur together.

Small patches on landscape approximately one acre to maybe 10ac in size - mapped by plot not imagery. This should probably encompass only 1% of the historical landscape.

This BpS's shrub component may be increasing within the 1141 mixedgrass prairie due to the longer current-day FRIs.

We should not be mapping a lot of this historically; most should be in 1141. This should be very, very infrequeent for MZs 29, 30 and 20. Should be <10% of landscape historically.

Maybe some Kentucky bluegrass in this BpS. Maybe annual bromes such as Japanese brome.

This system might appear departed currently due to increase of shrubs (mostly snowberry) in class C due to missed FRIs. See class C comments.

This may not be a separate system from the prairie matrix. Those areas that have increased shrub cover due to fire suppression should be considered part of Northwestern Great Plains Mixedgrass Prairie (CES303.674).

Native Uncharacteristic Conditions

Scale Description

Fires would generally range from 1000-10000ac, or up to 100000ac through BpS 1141. Based on topography, wind speed, fine fuel loading and fuel arrangement the fires would burn in a mosiac pattern. Extent of weather influences (wet-dry cycles) would have been very widespread.

Small patches on landscape approx 1 acre maybe 10 acres in size/ mapped by plot not imagery. 1 hectare

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would be a large patch. Very small.

Issues/Problems

Comments

This model for MZ20 was originally adopted from the Rapid Assessment model R4PRMGn Northern Mixed Grass Prairie created by Cody Wienk and Lakhdar Benkobi and reviewed by David Engle (dme@mail.pss.okstate.edu) and John Ortmann (jortmann@tnc.org). Descriptive changes were first made for MZ20 by BJ Rhodes (bj_rhodes@blm.gov), John Carlson (john_carlson@blm.gov), Bill Volk (william_volk@blm.gov), Rich Adams (rich_adams@blm.gov) and Amanda Keefer (akeefer@mt.blm.gov). These reviewers, however, did not feel they had a sufficient grasp or concept of the system to change the model. Some errors were found in the original RA model that violated modeling rules and were therefore changed by Regional Lead for MZ20. Brian Martin then reviewed the model and made quantitative changes. It was changed from the original five-box model to a three-box model. The changes and model were sent back out to the original reviewers to receive their input and get their consensus. After further review, it was decided that the model from MZs 29 and 30 for this type should be adopted for MZ20. Therefore, Jeff DiBenedetto's model was adopted. Reviewers' names for original MZ20 model were removed: Shannon Downey, BJ Rhodes and Steve Barrett.

Vegetation Classes

Class A 35 %

Early Development 1 Open

Upper Layer Lifeform

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

Fuel Model 1

Indicator Species* and Canopy Position

SCSC	Upper
CAFI	Upper
PASM	Upper
STIPA	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	50 %
Height	Herb 0m	Herb 0.5m
Tree Size Class	no data	

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

Shrub cover would range from 0-10%.

Description

Grasses such as little bluestem, western wheatgrass, stipa, bluebunch wheatgrass, side-oats grama and upland sedges dominate this class. This class is a combination of grasses and very short-stature vegetation resulting also from prairie dog disturbance (maybe only in draws - snowberry).

A variety of forb species such as fetid marigold, scarlet globemallow, scarlet gaura, skeleton weed and dotted gayfeather tend to dominate this class.

Some sprouting of snowberry, chokecherry and serviceberry.

The fuel in this class would be initially too sparse to carry fire, but then fuel increases.

This class lasts for nine years then succeeds to B, mid open state. (Although, if it were a dense stand initially and then re-sprouted, might take fewer than nine years to get to B.)

Replacement fire occurs every 30yrs, and sets this class back to its beginning stage.

Grazing (0.07 probability or 7% of this class each year), the combination of drought and grazing (0.02 probability or 2% of this class each year) and drought modeled as wind/weather/stress (0.05 probability or 5% of this class each year) all occur and maintain this class but don't set it back to its beginning state.

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Prairie dog impact occurs with a probability of 0.0035 (.35% of class each year) and returns this class to its beginning. The only shrub that prairie dogs might impact in this BpS would be the snowberry sites and draws/drainageways.

Class B **25%**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 1

Indicator Species* and Canopy Position

SYOC	Upper
JUHO2	Upper
PASM	Lower
STIPA	Lower

Structure Data (for upper layer lifeform)

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

☑ Upper layer lifeform differs from dominant lifeform.

Herbaceous cover is approximately 30-70% and 0.5m in height.

Description

More open community than late stage. Seedling shrubs.

Dominant shrubs coming in - snowberry, chokecherry, skunkbrush, creeping juniper and buffaloberry.

Western wheatgrass, needlegrasses, little bluestem and upland sedges, are common grasses - same as in class A. Bluebunch wheatgrass can be locally common with skunkbrush. Common forbs include scurfpea, prairie coneflower, Rocky Mountain beeplant, scarlet globemallow and dotted gayfeather.

Herbaceous cover is approximately 30-70% and approx 0.5m in height.

This class lasts nine years and then succeeds to the late development stage.

Replacement fires occur every 30yrs.

Grazing (0.02 probability or 2% of this class each year) and the combination of drought and grazing (0.01 probability), occur and cause a transition back to the early stage, A. Grazing (0.02 probability), the combination of drought and grazing (0.003 probability) and drought modeled as wind/weather stress (0.1 probability) can also occur while maintaining this class in this stage.

Prairie dog impact occurs with a probability of 0.0003, taking the class back to A.

Class C **40%**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 1

Indicator Species* and Canopy Position

SYOC	Upper
JUHO2	Upper
SHAR	Upper
SCSC	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21%	80%
Height	Shrub 0m	Shrub 1.0m
Tree Size Class	no data	

☑ Upper layer lifeform differs from dominant lifeform.

Herbaceous cover between 50-65% and 0.5m in height

Description

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**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.

Denser, higher canopy cover. Mature canopy.

Vegetation community is similar to previous class. Forbs are present still. Litter layer tends to be relatively continuous.

Herbaceous cover 50-65% and 0.5m in height.

Snowberry average cover could be 65% (DiBenedetto). Maximum up to 75%, minimum approx 45%. Skunkbrush cover average approximately 25%. Horizontal juniper average 44%, range of 25-65% cover. Each of the shrub species associated with own habitat type with moisture gradient. Skunkbrush is dry end, and snowberry/chokecherry is wet end.

Replacement fire occurs every 30yrs.

The combination of grazing and drought takes this class back to either A, an early state (0.001 probability), B, a mid-open state (0.001 probability) or maintains this class (0.002 probability).

Grazing alone causes a transition back to an early stage (0.002 probability), to a mid stage (0.003 probability) or maintains this class (0.005 probability).

Drought modeled as wind/weather stress also maintains this class, with a probability of 0.05 (or 5% of this class each year).

It is thought that historically, this class probably occupied even <15% of the landscape. It probably occupied approximately 5-10% of the landscape due to the frequency of fire in the adjacent mixedgrass prairie. Currently, however, there is probably much more of this class on the landscape due to missed FRIs - especially an increase in the snowberry shrubs on more mesic drainageways, draws and depressions - areas of higher available moisture.

Class D **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model

Description

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.

Class E **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model

Description

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.

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**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.

Disturbances

Fire Regime Group:** II

Historical Fire Size (acres)

Avg 10000
Min 1000
Max 100000

Sources of Fire Regime Data

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

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	30	8	30	0.03333	100
Mixed					
Surface					
All Fires	30			0.03335	

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
- [x] Native Grazing
- [x] Other (optional 1) prairie dog disturbance
- [x] Wind/Weather/Stress
- [ ] Competition
- [x] Other (optional 2) drought + grazing

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Station, Ogden, UT.

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**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011060 Northern Rocky Mountain Montane-Foothill Deciduous Shrubland

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

General Information

Contributors (also see the Comments field) **Date** 11/18/2005

Modeler 1	Mike Babler	mbabler@tnc.org	**Reviewer**	Steve Barrett	sbarrett@mtdig.net
Modeler 2			**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type
Upland Shrubland

Map Zone
20

Model Zone

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

Dominant Species*
AMELA
PURSH
SYMPH
PRUNU

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Minor but relatively widespread. Occurs throughout the Intermountain West and Northern Rockies. In MZ20, this type is limited to very limited in extent.

Biophysical Site Description
This BpS occupies draws and foothills (all aspects) in the transition zone between grasslands/shrublands and forests, including aspen and montane forests. Ranges widely in elevation (3000-9000ft) throughout its geographic range.

Vegetation Description
Various mixes of shrubs such as serviceberry, Prunus spp, snowberry, snowbrush, bigtooth maple and Rocky Mountain maple. (Society of Range Management Cover Types 317-319, 418-421.)

Disturbance Description
Fire Regime Group IV, dominated by replacement fire (80%), but may have a small component of mixed severity fires (20%). The average fire return interval for this system may range from less than 60yrs to 100yrs+, and there is some debate about the role of mixed severity fire. Fire regimes of adjacent BpS will have significant impact on the frequency and severity of this BpS. One reviewer for MZ20 also felt that the contagion effect from the adjacent dominant BpS types might have produced a lower MFI than what was modeled. This BpS will have significant variation in plant response to disturbance.

Drought, insects/disease and native grazing may all impact this BpS. However, little or no data exist to attribute these disturbances, and they were not included in this model.

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Adjacency or Identification Concerns

The fire regime of adjacent BpS will influence (ie, contagion effect) the fire regime here. This system is widespread and may be adjacent to many shrubland systems, mountain grassland systems and forested types including montane aspen, ponderosa pine and Douglas-fir forests.

Native Uncharacteristic Conditions

Scale Description

Variance in scale is a result of topography and localized moisture variability.

Issues/Problems

Extreme variability in fire regime, scale and adjacency make this type difficult to model.

Comments

This BpS for MZ20 was adopted as-is from the same BpS from MZ19. No quantitative changes were made. Minor descriptive additions were made to more fully describe the system. Some class structural changes were made to match the descriptive boxes.

For MZs 10 and 19, reviewers were Don Bedunah (bedunah@forestry.umt.edu), Clayton Kyte (clayton_kyte@nps.gov, Susan Miller (smiller03@fs.fed.us), Lois Olsen (lolsen@fs.fed.us), Robert Wooley (rwooley@fs.fed.us) and one anonymous reviewer. Derived from the Rapid Assessment model R0MTSB (Mountain Shrub, non-sagebrushes). The model was taken as-is.

One reviewer for the RA felt that the overall MFI should be reduced and dominated by mixed severity fire. The other reviewers agreed with the fire frequency and severity in the model, and it was unchanged.

Peer review for the Rapid Assessment model incorporated on 4/11/2005. Additional reviewers included Thor Stephenson (thor_stephenson@blm.gov), Curt Yanish (curt_yanish@blm.gov) and Gavin Lovell (gavin_lovell@blm.gov). Peer review from RA resulted in the addition of some mixed severity fire. There were disparate opinions about the frequency of fire in this type, ranging from an average fire return interval of 60-100yrs. Adjusting the MFI either direction resulted in only slight adjustments (+/-5%) in the resulting percent in each class.

Vegetation Classes

Class A **10%**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

Indicator Species* and Canopy Position

AMELA	Upper
SYMPH	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0%	20%
Height	Shrub 0m	Shrub 0.5m
Tree Size Class	None	

☑ Upper layer lifeform differs from dominant lifeform.

Description

Grasses and forbs will dominate, with scattered shrubs in overstory. Grass cover may reach 100%.

Early succession, usually after frequent stand replacement fires. Dominated by grasses and forbs, with some shrubs sprouting. Grass/forb canopy cover will be high and variable (0-100%), but cover of shrubs will be <15%.

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This class succeeds to B after ~10yrs.

Replacement fire occurs every 100yrs.

Class B **45%**

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

Indicator Species* and Canopy Position

AMELA	Upper
SYMPH	Upper
LUPIN	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	40 %
Height	Shrub 0.6m	Shrub >3.1m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Less than 40% shrub cover, with sprouting shrubs dominant in scattered openings.

This class succeeds to C after ~70yrs unless replacement fire occurs (causing a transition to class A), every 100yrs. Mixed severity fires will not cause a transition to another class, and occurs every 400yrs.

Class C **45%**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

Indicator Species* and Canopy Position

AMELA	Upper
SYMPH	Upper
LUPIN	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	60 %
Height	Shrub 0m	Shrub >3.1m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Greater than 40% shrub cover; all age classes present but dominated by overmature shrubs and sparse understory except in gaps.

This class persists indefinitely, unless a disturbance (replacement fire every 100yrs or mixed severity fire every 400yrs) cause a transition (to classes A and B, respectively).

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

Description

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.

Disturbances

Fire Regime Group:** **IV**

Historical Fire Size (acres)

Avg 0
Min 0
Max 0

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☐ Expert Estimate

Fire Intervals	*Avg FI*	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	100	20	150	0.01	80
Mixed	400			0.0025	20
Surface					
All Fires	80			0.01251	

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

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**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.

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**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011170 Southern Rocky Mountain Ponderosa Pine Savanna

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

General Information

Contributors (also see the Comments field) **Date** 6/16/2006

Modeler 1 Steve Barrett	sbarrett@mtdig.net	**Reviewer**	
Modeler 2		**Reviewer**	
Modeler 3		**Reviewer**	

Vegetation Type
Upland Savannah/Shrub Steppe

Map Zone
20

Model Zone

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

Dominant Species*
PIPO SCSC
FEID
PSSP6
AGROP2

General Model Sources
☑ Literature
☐ Local Data
☐ Expert Estimate

Geographic Range
Ponderosa pine is widely distributed throughout North America occupying about 38 million acres across 14 states. Ponderosa pine savanna is much more restricted than the ponderosa pine woodlands. Ponderosa pine savanna is typically found throughout the inland west of North America in the foothills and montane zones, generally in the grassland/forest ecotone. Elevation range from 335m in BC to 2700m in the southwest.

This BpS is thought to be limited to moderate in extent in MZ20. Presettlement amount was appreciable, but current data does not reflect that.

Biophysical Site Description
This type occurs primarily on rolling plains, plateaus and dry slopes in the foothills and montane zones. This type is usually found on southerly aspects and drier sites.

Vegetation Description
This system is best described as a savanna that has widely spaced Pinus ponderosa or open and park-like stands dominated by Pinus ponderosa. Understory vegetation in the true savanna occurrences is predominantly fire-resistant grasses and forbs that resprout following surface fires; shrubs, understory trees and downed logs are uncommon.

Important species include grasses such as Agropyron spp, Festuca, spp, Pseudoroegneria spicata, Andropogon gerardii, Schizachyrium scoparium and Bouteloua gracilis.

Disturbance Description
Under presettlement conditions, interior ponderosa pine forests were subject to frequent, low severity fires (Fire Regime Group 1) (Bradley et al. 1992). Mean fire return interval for this type generally averaged

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between 10-25yrs (Barrett 2004). Mean FRI for low-severity fires is approximately 10-25yrs, with shorter intervals in more open stands. The mean FRI for mixed severity fires averaged between 50yrs (closed stands) to 80yrs (open stands). Replacement fire is rare, but more frequent in closed stands, averaging between 250yrs, versus open stands, averaging FRI of 800yrs.

Mountain pine beetle is the most significant insect impacting this system. Mountain pine beetle outbreaks increase with stand density with return interval of 100yrs on average. Closed stands above 40% cover are attacked by pine beetle, resulting in older trees being selectively killed and sometimes younger trees too.

Dwarf mistletoe is also an important disturbance in stands without fire or a secondary result of insect attacks.

Adjacency or Identification Concerns

Found adjacent to BpS 1141 Northwestern Great Plains Mixedgrass Prairie and lower montane forest types such as BpS 1045 Northern Rocky Mtn Dry-Mesic Montane Mixed Conifer Forest.

This type may be easily confused with BpS 1054 Southern Rocky Mountain Ponderosa Pine Woodland, especially when fire-suppressed. Check the biophysical site description boxes so as not to misclassify this BpS with other similar types. Distinguishing between the savanna and woodland ecotypes can be difficult, especially in areas heavily impacted by fire exclusion and grazing, which have promoted substantial tree encroachmnet in these BpS types and adjacent grasslands.

In MZ20, presettlement amount was appreciable, but current data does not reflect that (Cooper, pers comm).

A century of anthropogenic disturbance such as livestock grazing and fire suppression has resulted in a higher density of Pinus ponderosa trees, altering the fire regime and species composition. Presently, many stands contain understories of more shade-tolerant species, such as Pseudotsuga menziesii, as well as younger cohorts of Pinus ponderosa.

Many scattered PIPO patches in the Great Basin were completely logged during the mining era of 1850-1900 and during the railroad construction era throughout the western USA. It is also thought that the dominance of shrubs in understories is greater today than during presettlement because livestock grazing greatly reduced grasses. Therefore, shrubby woodlands today may have been grassy savannas in the past.

Native Uncharacteristic Conditions

Scale Description

Ponderosa pine savannas are naturally limited in size in the Interior West. Although large fires have been noted in ponderosa pine in the past, these are thought to occur in ponderosa pine woodlands, not the smaller savannas.

Issues/Problems

Ponderosa pine savanna should be better researched.

Comments

This model for MZ20 was adapted from the same BpS in MZ23, created by Mark Loewen (mloewen@fs.fed.us), Doug Page (doug_page@blm.gov) and Beth Corbin (ecorbin@fs.fed.us) and reviewed by an anonymous reviewer. Descriptive and quantitative changes were made to better reflect MZ20 as well as to correspond better with the descriptive boxes.

This model for MZ23 is identical to the model for the same BpS in MZ16 (Utah High Plateaus) with minor

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descriptive changes based on peer review for MZs 23 and 24. Modifications were made to the Rapid Assessment PNVG R2PIPO by Mark Loewen, Doug Page and Beth Corbin. Stanley G. Kitchens (skitchens@fs.fed.us) was a reviewer of the original R2PIPO.

Vegetation Classes

Class A 2%

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 1

Indicator Species* and Canopy Position

PIPO	Upper
FEID	Lower
PSSP6	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	30 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Description

Graminoids are dominant, with occasional sprouting shrubs. Grass would be short to medium in height, and range in canopy cover from 0-100%.

Graminoid dominated community following stand replacement fire. Sprouting shrubs on more moist site can occur. Conifer seedlings are scattered throughout, but are typically found in dog-hair type thickets. Age class: 0-15yrs. DBH. range of 0-2in. Succession to B, mid-development closed, after 15yrs, although this class can succeed to C, the mid-open stage via an alternative successional pathway, 10% of the time. The FRI of replacement fire is 15yrs.

Class B 10%

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 4

Indicator Species* and Canopy Position

PIPO	Upper
FEID	Lower
PSSP6	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	60 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Greater than 30% canopy cover from sapling to pole size pine. Understory species decreasing to depressed. DBH. range of 2-14in. Age class: 15-100yrs.

Succession to E, late-development closed class, unless replacement fire (mean FRI of 250 yrs) returns vegetation to class A, or mixed severity fire (FRI of 50 yrs) or mountain pine beetle outbreaks (return interval of 100yrs) cause a transition to the mid-development open condition (class C). Low-severity fire is not assumed possible in this closed condition as any fire would at least cause mixed severity fire effects.

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Class C 20 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 1

Indicator Species* and Canopy Position

PIPO	Upper
FEID	Lower
PSSP6	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	30 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Less than 30% canopy cover of pole to saw timber size trees with diverse understory of grasses and forb species. Open structure maintained by low intensity and mixed severity fire. DBH range of 2-14in. Age class: 15-99yrs.

Replacement fire is infrequent in the open condition (average FRI of 800yrs). Surface fire (FRI of 15yrs) and mixed severity fire (FRI of 80yrs) maintain the open structure of the stand and prevent closure of the vegetation. If there is no fire for 25yrs, vegetation will transition to mid-development closed class (B). Vegetation will succeed to late development open (class D) after 85yrs with fire activity.

Class D 65 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

PIPO	Upper
FEID	Lower
PSSP6	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	30 %
Height	Tree 10.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Less than 30% canopy cover with scattered trees saw timber size trees throughout, creating a savanna-like appearance with diverse grass and forb species dominating the understory. DBH range of 14in+. Age class: 100yrs+ old.

Replacement fire is infrequent in this condition (every 800yrs). Compared to other classes, low-severity fire could be at its most frequent rate; however, it was modeled at a 15yr interval, and mixed severity fire (mean FRI of 80yrs) is at its least frequent rate in the opened stages of C and D. Fire prevents the transition to a closed structure (class E), which will happen after 50yrs without fire. Otherwise, the vegetation will remain in class D indefinitely.

Class E 3 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 10

Indicator Species* and Canopy Position

PIPO	Upper
PSEUD7	Upper
FEID	Lower
PSSP6	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	60 %
Height	Tree 10.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

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**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.

Greater than 30% canopy cover of decadent trees. Severely suppressed to poorly developed understory. Douglas-fir may be present. Age class: 100yrs+. DBH range of 14in+.

Replacement fire will return vegetation to class A (mean FRI of 250yrs), whereas mixed severity (FRI of 50yrs) will open stand structure and cause a transition to class D. Mountain pine beetles (return interval of 100yrs) will cause a transition either to class C (75% of the time) by selectively killing older trees or to class D (25% of the time) by thinning mostly younger trees and some older ones. Without fire, the stand remains closed indefinitely.

Disturbances

Fire Regime Group:** I

Historical Fire Size (acres)

Avg 100
Min 10
Max 500

Sources of Fire Regime Data

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

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	385	150	800	0.0026	4
Mixed	75	50	80	0.01333	20
Surface	20	10	25	0.05	76
All Fires	15			0.06593	

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

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011250 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** 2/15/2006

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Modeler 3			**Reviewer**		

Vegetation Type

Upland Savannah/Shrub Steppe

Map Zone

20

Model Zone

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

Dominant Species*

ARTRW PSSP6
PASM HECO26
BOGR2 NAVI4
CHRYS9 CAFI

General Model Sources

☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

This system encompasses eastern and central MT, as opposed to throughout the Rocky Mountains, etc., as BpS 1125 in other zones usually refers to. Common throughout MZ20 currently (not necessarily historically), except in western part of section 331Da. However, BpS 1080 might be more common.

Biophysical Site Description

This system is more similar to Great Plains Sagebrush Steppe for MZ20. For MZ20, we are describing Great Plains Sagebrush Steppe, but it is "in" BpS1125, as CES303.NEW does not yet exist for LF nomenclature.

Note that BpS 1125 is the more productive BpS between it and 1080.

Geology defines this system (Great Plains Sagebrush Steppe) as different from the Intermountain sagebrush systems of BpS 1125. 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 Artemisia tridentata ssp. vaseyana is not part of the mix in MZ20. Soils

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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).

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 the MZ20 expression of this BpS. 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 E.A. but 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 this map zone.

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.

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 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 higher potential for herbaceous species, on ARTTST (ssp. tridentata) sites; no definitive statement on undergrowth herbaceous diversity can be made for ARTTSW (ssp. wyomingensis) sites. Herbaceous cover increases are transitioning into the mixed-grass prairie.

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 (eg, 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 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 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 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 occuring 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 said that we are fairly

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certain of the recovery time required (50-150yrs, mostly around 100yrs). 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 mapzone 20, FRI was modeled at an overall 90yr interval, similar to other adjacent mapzones and similar to BpS 1080 FRI of 80yrs, which this BpS is thought to be very similar to.

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

Adjacency or Identification Concerns

Please note that the only difference between this BpS 1080 and BpS 1125 is in the amount of herbaceous cover. In MZ20, 1080 is by far the more prevalent type, when considering pre-Euro reference conditions. BpS 1125 might be more prevalent today in MZ20 due to overgrazing.

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. In areas of extensive severe burns without adjacent seedbanks, it would take a long period of time 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.

It might also be difficult to distinguish BpS 1085 from 1125. BpS 1085 also differs in FRI from 1125, which is also composed mostly of Wyoming big sagebrush. BpS 1085, however, has a higher grass component. Up north, where there is a heavy grass component, much less cover of sage than what is down south, relatively connected topography and a lot of wind, it would burn more frequently (Downey, pers comm). And even though BpS 1085, which is also comprised mainly of Wyoming big sagebrush has an FRI of 30yrs, these two systems are different in setting, precipitation patterns, and continuity of fuel. Eastern MT has few fire breaks, whereas mountain systems are much less likely to have large continuous fires. Although the species are the same, Wyoming big sagebrush - the systems aren't (Martin, pers comm).

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 Northern Great Plains 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

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can be an increaser with burning/grazing. There is also BROTEC invasion but that doesn't occur in the Northern Great Plains.

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

Shrub cover increases in MZ20 with overgrazing, and herbaceous layer decreases dramatically.

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

Native Uncharacteristic Conditions

In MT, >30% canopy cover of Wyoming big sagebrush.

Scale Description

Occurrences may cover between hundreds and thousands of hectares.

Issues/Problems

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

Comments

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 one 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 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-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

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Class A 35 %

Early Development 1 All Structures

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	no data	

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

Description

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.

Herbaceous dominated. In the presettlement condition, NAVI4 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 ARTTSW 15yrs post-fire and another paper for MZ19 that indicates no recovery after as much as 18yrs (Cooper, personal correspondence).

Insect/disease (0.001 probability or 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 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 percentage from 20% to 35%.

Class B 35 %

Mid Development 1 Open

Upper Layer Lifeform

- [ ] Herbaceous
- [x] 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	no data	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

Sagebrush canopy is greater than five percent cover but less than 15%. Understory is well represented by herbaceous species as described for class A. (Montana Academy of Sciences publication - re: in breaks, 15yrs after fire, no sage yet.)

ARFR4 also present in lower canopy.

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Succession to class C, late development closed stage, occurs after 50yrs.

Insect/disease (0.001 probability or 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 1% of the landscape each year) occur, but do not cause a transition to another stage.

Fire 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.

Class C **30 %**

Late Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☑ Shrub
☐ Tree

Fuel Model 2

Indicator Species* and Canopy Position

ARTRW	Upper
PASM	Mid-Upper
NAVI4	Mid-Upper
HECO26	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	30 %
Height	Shrub 0m	Shrub 0.5m
Tree Size Class	no data	

☐ 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.

ARFR4 is also present in lower canopy.

Insect/disease (0.001 probability of 0.1% of the landscape each year) and 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%.

Class D **0 %**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Indicator Species* and Canopy Position

	Upper
	Middle
	Middle
	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

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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
Min
Max

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ 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

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

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011260 Inter-Mountain Basins Montane Sagebrush Steppe

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

General Information

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

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Modeler 3			**Reviewer**		

Vegetation Type

Upland Savannah/Shrub Steppe

Map Zone

20

Model Zone

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

Dominant Species*

ARTRV SYOR2
PSSP6 BASA
FEID
POSE

General Model Sources

☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

Scattered throughout the zone in MZ21. In MZ20, it is thought to be very limited to limited in occurrence. It might occur at the very south, extreme end of MZ20.

Biophysical Site Description

In MZ21, this type ranges from 6000ft and can occur up to 9900ft (Bridger-Teton National Forest) in the southern portion of the zone. In southwest MT, it could occur up to 9600ft (Lesica et al. 2005). The elevation range over multiple mapzones might be 4000-9900ft. It has been suggested, however, by a reviewer for MZ21, that this BpS 1126 perhaps ends at approximately 9500ft which may indicate that grassland systems, with a few shrubs interspersed, might start above that elevation.

It is scattered in forest openings throughout the zone, and adjacent to lower forested areas.

This vegetation type is found on all aspects, although it rarely occurs on northerly slopes. Pure stands are found in areas with deeper soils and less topographic relief, but it is also common on slopes with a gradual shift to a mixed mountain shrub community on steeper slopes and in drainages. Precipitation ranges from 12-20 in/year. Soils are deep, well drained. Soil moistures are udic (not dry for as long as 90 cumulative days) and soil temperatures cryic (very cold soils of the Rocky Mountain Region).

In the high valleys of southwestern MT, sagebrush was probably the historical dominant on sites having either coarse or clayey soils (Morris et al. 1976 in Arno and Gruell 1983). Grasses are poorly adapted to these soils, which have droughty surface conditions, whereas deep-rooting big sagebrush is well-adapted (Arno and Gruell 1983). On the widely distributed loamy soils, prior to 1900, sagebrush might have been

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restricted to small patches or widely spaced plants. The fine-textured soils have good potential to support dense stands of grass (Arno and Gruell 1983).

Vegetation Description

Mountain sagebrush steppe dominated by mountain big sagebrush, with a frequent presence of mountain snowberry, with a continuous grass and forb understory is believed to be a major pre-settlement vegetation type for within this map zone, although the exact composition of the community before settlement is unknown.

Dominant shrubs include mountain big sagebrush (Artemisia tridentata ssp. vaseyana), antelope bitterbrush (Purshia tridentata, in MZ 10) and mountain snowberry (Symphoricarpos spp). Other common shrubs include serviceberry (Amelanchier alnifolia), wild cherry (PRVI), rose and currant and rabbitbrush (CHRYS9). Other shrubs may be locally common.

Herbaceous cover is moderate to abundant ranging from 40-85%. Common grasses include: Festuca idahoensis, Agropyron spicata (now Pseudoroegneria spicata), Elymus elymoides, Elymus trachycaulus, Hesperostipa comata, Koeleria cristata and Poa secunda. Common forbs include Eriogonum umbellatum, Antennaria microphyla, Balsamorhiza sagittata, Lupinus spp, Delphinium spp, Castilleja spp and Geranium viscosissimum and Astragalus purshii.

This vegetation type may occur as inclusions within forested types.

Disturbance Description

GENERAL
Fire is a major disturbance factor for mountain big sagebrush (Blaisdell et al 1984, Johnson 2000). The fire return intervals reported in the literature for this type vary from 10-70yrs (Hironaka et al. 1983, Miller and Rose 1999, Wright and Bailey 1982; Houston 1973; Arno and Gruell 1983) and up to 200yrs (Baker in press).

The model for MZ21 was based on the model for MZs 10 and 19; however, major quantitative changes were made. The model for MZs 10 and 19 employed an overall fire return interval of 26yrs (100yrs for replacement fire; 35yrs for mixed fire). The model for MZ21 was originally modeled with a FRI of 175yrs in A, 130yrs in B and 130yrs in C, for an overall FRI of 135yrs. Initial reviewers suggested an overall 50-70yr interval. After much debate, as described below, the Regional Lead chose an interval of 50yrs, which was accepted by Tart and Kitchen. One anonymous contributor disagreed and presented evidence to the contrary. The Regional Lead, therefore, chose an interval of 80yrs, which was then met with disapproval by Tart, Kitchen, and others, which led to the request that these issues be elevated to LANDFIRE leadership. Kitchen recommended an interval of 60yrs in order to reach a compromise.

20-50 YEAR INTERVAL
Tart (personal correspondence) states that the studies most relevant to MZ21 are Houston (1973) and Arno and Gruell (1983). Neither reported CFI over a large area. Houston (1973) reported single tree FI from 36-108yrs for the life of the tree up to 1970; the average for the subunits of the study area ranged from 53-96yrs on trees (adjacent to shrubland); they adjusted to account for fire frequencies prior to modern man, to get an MFI resulting in 32-62yrs on representative, unprotected sites for the period through 1890 (pre-suppression), with a mean of 49yrs. Also, to evaluate single-tree values, Houston used six groups of 2-3 cross-dated trees to account for missing scars. Trees within a group were 5-25m apart. The MFI resultant values ranged from 17-26yrs with a mean of 22yrs on representative, unprotected sites.

Arno and Gruel (1983) reported intervals between 22-60yrs, with a mean of 43yrs for the Douglas-

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fir/shrub/grass ecotone, based on tree fire scars adjacent to shrubland. They both report MFI values for either single trees or small areas (Tart personal correspondence).

However, the anonymous contributor (personal correspondence) states that Houston's (1973) value of 53-96yrs (and 32-62yrs in pre-Euro) is a composite fire interval estimate from 34 trees in a set of seven units, within which trees were composited (Houston Table 1). The individual tree values are only given in the text as "36-108yrs" across the sample (p. 1112). Houston's "intra-stand" estimates of 20-25yrs are CFI estimates. Note that these trees also are not scattered within the steppe as in the first sample, but are from along the forest ecotone (p. 1113). Thus, Houston's estimate of 20-25yrs requires correction for adjacency and for unburned area.

The anonymous contributor (personal correspondence) also states that Arno and Gruell also used an extreme form of targeting and a very insufficient sample size (n = 1) at 8 sites and did, in fact, make a composite at the other four sites. Houston (1973) and Arno and Gruel (1983) do need correction for unburned area and adjacency in both cases, as both were collected along the forest-grassland ecotone (anonymous contributor, personal correspondence; Baker in press), and neither used crossdated scars.

The anonymous contributor also states that Houston (1973) and Arno and Gruell (1983) are about grasslands, not mountain big sagebrush stands in the pre-Euro landscape (see below regarding adjacency issues). He also states that neither study crossdated scars, so we really cannot tell whether fires did or did not burn among trees scattered across landscapes in the Houston study area or whether separate fire years really are valid in the Arno and Gruell study.

35-40 YEAR INTERVAL
Heyerdahl et al. (in press) document four large fires in Douglas-fir/mountain big sagebrush sites during their reporting period of 1700 to 1860 (figure 3b) and possibly two more between 1650 and 1700 (figure 2). Using these values gives MFIs of between 35-40yrs, or 37yrs on average. The range of variation in fire occurrence under this regime was 2-84yrs. In other words, between the years 1700-1860, on some portions of the landscape, fire had a point or plot interval of about 37yrs with intervals as short as two years and as long as 84yrs. This frequency is also comparable to the frequency estimated by modeling studies to exclude Douglas-fir (approximately 30yrs, Keane et al. 1990), and to that reconstructed from tree rings in Douglas-fir/mountain big sagebrush elsewhere in southwestern MT (20-40 mean intervals, Houston 1973, Arno and Gruell 1983, Littell 2002) where frequent past fires are also thought to have prevented the establishment of Douglas-fir. They believe that fires likely burned the area between plots with evidence of fire in the same year, including across historical sagebrush-grass plots (Heyerdahl et al in press).

Heyerdahl et al (in press) also state that after fire, mountain big sagebrush at sites in southwestern MT required up to 30yrs to return to >20% cover (Wambolt et al. 2001 in Heyerdahl et al. in press).

As per Tart (personal correspondence), another approach to estimating MFI in the shrub/grass areas beyond the forest ecotone is to consider only large fires documented from both sides or scattered across the shrub/grass area (Baker in press; Kitchen, personal communication). This method can be used with the data of Houston (1973) (see his Table 3) and Miller and Rose (1999) (see their Figure 4). Applying this approach to both data sets to calculate MFI for large fires for the period 1650 to 1890, the results are: Miller and Rose (1999) between 27-34 MFI; Houston (1973) between 30-40 MFI. Using the more restrictive definitions of large fire for the period 1700-1890 gave an MFI of 32yrs for both study areas.

50 YEAR INTERVAL
According to Miller and Rose (1999) and Wright and Bailey (1982), there is a 50yr MFI. However, those

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studies did not take into account the limitations of fire history data or the recovery rate.

Based on what has been shown through different approaches and field experience of those who know the system, the estimate of total MFI for mountain big sagebrush steppe is between 40-80yrs (Kitchen, personal correspondence).

50+ YEAR INTERVAL
Welch and Criddle (2003) report greater than 50yr interval. They also report the following "10 biological and ecological characteristics of mountain big sagebrush do not support the idea that mountain big sagebrush evolved in an environment of frequent fires of 20-30yrs: (1) a life expectancy of 70yrs+ (2) highly flammable bark (this stringy bark makes excellent fire starting material); (3) production of highly flammable essential oils; (4) a low growth form that is susceptible to crown fires (5) nonsprouting; (6) seed dispersal occurs in late fall or early winter long after the fire season has ended; (7) lack of a strong seed bank in the soil; (8) seed lack anatomical fire resistance structures or adaptations – that is, a thick seed coat; (9) seeds must lie on the soil surface, which exposed them to higher temperatures than seeds that occur deeper in the soil; (10) seeds lack any adaptations for long distance dispersal, hence, mountain big sagebrush lack the ability for rapid reestablishment. Thus it appears that an estimated fire interval of 20-30yrs for mountain big sagebrush is too low and that the natural or normal fire interval is much longer, perhaps 50yrs or more."

70-200 YEAR INTERVAL and RECOVERY
Recovery rates should also be taken into account (Baker in press). Mountain big sagebrush has the fastest recovery rate of the three subspecies of big sagebrush (Johnson 2000, local data). Rates of recovery under the natural disturbance regime most likely were longer than we see in small burns today (anonymous contributor, personal correspondence). It is not necessarily preferred to use a fixed percent cover as a standard for recovery, as the percent cover of ARTRV varies widely with environment.

The anonymous contributor (personal correspondence) suggested a 70-200yr MFI interval. Recent data from long term vegetation transects collected over a twenty year period in WY suggest that the recovery of mountain sagebrush steppe communities following fire requires at least 25yrs in northwestern WY and at least 40yrs in southern WY to reach a late seral state with > 30% sagebrush cover (Grand Teton National Park/Bridger Teton National Forest Fire Effects Monitoring Data, Southern Wyoming Fire Zone BLM Fire Effects Monitoring Data). If recovery rates are correlated with composite fire return intervals, fire return intervals may lie somewhere between 40-60yrs. However, recent data show that fire return intervals may be twice or more as long as recovery periods, indicating a fire return interval of 70-200yrs (Baker in press). If FRI is two times as long as recovery, it might be that the FRI in this system is at least between 50yrs to at least 80yrs. However, the reason the range goes up to 200yrs is because Bruce Welch at USFS Provo Shrub Lab has observed that in large fires, ARTRV reseeds very slowly, creeping in from the edge at rates that suggest it will require perhaps 100yrs to fully recover. There is wide variation in recovery rate (Lesica et al 2005). In recent work and new data (Lesica et al. 2005), it seems that most ARTRV will not recover in 25-40yrs, but some will. So the lower end of recovery would be 25-40yrs, and the upper end of the recover curve may be quite long, 100yrs. Thus, the 100yr figure gets multiplied by two to produce the high end estimate of 200yrs (Baker in press). The midpoint would probably lie in the 100yrs+ range (anonymous contributor, personal correspondence).

This methodology has been debated by some researchers. Some do not advocate the use of the “two” multiplier of the recovery rate, to arrive at the fire interval.

CORRECTION FACTORS – 60 VS 240yrs
The anonymous contributor (personal correspondence) advocates use of correction factors for most of the

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studies above. If applying correction factors to Heyerdahl's study, a fire rotation of between 240yrs (anonymous contributor, personal correspondence) is reached. Fire rotation is: (period of estimate)/fraction of area burned. He estimated the fires to be 10, 160, 70, 35, 100, 210, 30, 40, and 210 ha for a total of 865 ha, but each fire has unburned area. Using the 21% correction for sagebrush fires gives an estimated total of 683 ha burned in a study area of 1030 ha (66.3% of the area or a fraction of 0.663) over the period from 1700 to 1860 (160yrs). Thus, the fire rotation is estimated as: 160yrs/0.663 = 241yrs. The fire rotation/population mean fire interval is thus about 6 to 7 1/2 times the composite fire intervals, consistent with what has been seen in other empirical comparisons.

Kitchen (personal correspondence) counters that by stating that to calculate an accurate estimate of fire rotation using the anonymous contributor's approach, a basal area considerably smaller than the 1030 ha (study area) would have to be used. Just as one cannot assume a fire interval for the non-recording portions of the landscape, one also cannot assume a fire free period for the whole test period. Either assumption introduces bias. Therefore all of the unsampled but fire scarred portions of the landscape would have to be subtracted from the base study area before calculation. In other words, Heyerdahl's fire sizes are at most conservative estimates of actual areas burned and probably miss fires that went unrecorded. Kitchen therefore used a modified approach to arrive at a fire rotation interval. He visually added up total burn area from figure 2 as the anonymous contributor did and got 1340 ha in 11 fires. An unburned area correction factor should not be used. If it is assumed that the sampled area (portion of study area with fire record) was half the total study area (ball park guess looking at the map) or 515 ha then a fire rotation of 61.5yrs is reached.

Kitchen (personal correspondence) also counters the anonymous contributor's estimate by stating that in Heyerdahl's study, fire was largely lost from the system after 1860 (figure 2). Concurrent with that loss just 146yrs ago, the range and density of Douglas-fir and lodgepole pine trees has increased dramatically throughout the study area. The beginning of heavy use by livestock coincides with the late 1800's shift. If that much has changed in 146yrs, it is not possible that a fire rotation of 241yrs would have been sufficient to maintain the pre-1860 woodland/shrubland mosaic documented by this study.

ADJACENCY
Tart (personal correspondence) states that this BpS in this mapzone was occupied by a mosaic of grassland and varying densities of big sagebrush. The FRI of sagebrush PNV sites historically maintained as grasslands is generally reported to be 10-40yrs (Winward 1991; Arno and Gruel 1983; Houston 1973). The longer intervals reported by Baker in press and Welch and Criddle would imply that there was little grassland (Tart, personal correspondence).

There is some disagreement as to whether the sites studied by Arno and Gruell, and Houston, apply to PNV of mountain big sagebrush or sites invaded by sagebrush. Baker states that in western MT (Sindelar 1981), grasslands invaded by ARTRV are not fire maintained, and instead livestock grazing removes the grass competition leading to ARTRV invasion.

For those areas that might be maintained as grassland along ponderosa pine or Douglas-fir ecotones, FRI, reported as CFI, has been indicated between 10-40yrs (Winward 1984; Winward 1991; Johnson 2000; Miller and Tausch 2001; Tart 1996) and greater than 50yrs (Welch and Criddle 2003) and between 35-100yrs (Baker in press). Again, interpretation of the estimates and corrections used varies.

Estimating historic fire regimes for sagebrush ecosystems is tenuous at best and often based on fire scar and age structure data from adjacent forest types (eg, ponderosa pine and pinyon/juniper), shrub age structure and fuel characteristics. Mountain big sage is also adjacent to Douglas-fir and lodgepole pine. The intervals

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for these adjacent types could be used for the sagebrush; they range from 30-130yrs. This is a vegetation type for which we do not have much confidence in the intervals or interpretation of intervals in the literature (Romme, personal correspondence).

SEVERITY
The severity of fire is also debated in this system. While the majority of fires were likely stand-replacing, some mixed severity fire may have occurred, though there is little data documenting mixed severity fires (Sapsis and Kaufmann 1991). Mixed severity fires were likely small in area, but ignitions may have occurred as frequently as 5-20yrs. There were probably also portions of this system that never carried fire because of sparse fuels (Bushey 1987). Historic fires likely occurred during the summer months and were wind-driven events. Lightning ignitions are variable and affect fire frequency on regional landscapes in the Northern Rockies. Fire may spread from adjacent forested communities.

ERRORS, VARIABILITY AND SUMMARY
Just as there exists a potential for error from estimating a shorter than real FI when compositing, there is also an opposing risk of estimating a longer than real FI by using an incomplete record of fire (temporally due to missed fires or spatially due to underestimation of fire size, or both). Both sources of error should receive further attention (Kitchen, personal correspondence). If we base estimates of the extent of historical fires on the evidence recovered, much will be lost, as evidence tends to be lost due to decay, erosion, subsequent fires, etc. There is therefore a good probability we will consistently underestimate fire size and frequency. Missed fires result in longer than real estimates of fire rotation (Kitchen, personal correspondence).

There is much variability in the fire intervals in this system. In the late 1800's the interval was shorter than the early 1800's (Romme, personal correspondence). There was a big shift in the late 1800's with fire intervals, whereas it could have been longer in the early 1800's, more akin to present day, due to climate (Tausch, personal correspondence). Fire regimes also vary considerably across the biogeographic range of mountain big sagebrush, based on factors like elevation, soil depth, slope, aspect, adjacent vegetation, frequency of lightning and climate. The climate, slope, aspect, soil and elevation can vary widely and thus the fire interval for this system can be as low as 30yrs to several hundred years, depending on what is surrounding the system. Although an average value could be chosen, and perhaps it lies in the 50yr range, most fire intervals would probably not be at the average value (Tausch, 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. We really do not know how fire might have behaved across the fuel threshold at the forest/shrubland ecotone. Therefore, we do not know how accurately proxy fire chronologies derived from fire-scarred trees predict fire regimes in nearby shrublands (Kitchen, personal correspondence).

When inputting differing fire probability values in VDDT, the following class percentages were output (early 0-13; mid 14-40; late 41--):
30-year interval: 35/45/20
50-year interval: 25/45/30
80-year interval: 15/45/40
100-year intrval: 10/45/45

When the longer fire interval parameters were used in VDDT, the proportion of the landscape in the earlier classes declined. Tart and other experts felt that those percentages of the landscape successional classes were not indicative of what would have been found historically. Succession class A needs to incorporate grass/forbs, and it should have been more prevalent on the landscape. Whereas the anonymous contributor

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and others contended that there is no knowledge of what percentage of the successional classes could be found on the landscape historically.

After these issues were elevated to LANDFIRE leadership, the 50yr interval was decided upon. This interval was also that used in MZs 18 and 23. MZs 10 and 19 used a 26yr FRI, and MZ22 used an 80yr FRI.

Adjacency or Identification Concerns

Differentiation of mountain big sagebrush steppe from Wyoming big sagebrush may be difficult at the ecotone due to physical similarities and hybridization zones (ie, species concepts become blurred).

Adjacent plant associations on shallow clay soils are dominated by Wyoming sagebrush. Shallow clay soil inclusions also support Artemisia arbuscula.

In MZ21, there is most commonly Douglas-fir and sometimes lodgepole pine encroachment. Douglas-fir trees have encroached into sagebrush-grasslands from historically stable tree islands and tree density has increased on the tree islands (Heyerdahl et al. in press). Mountain big sagebrush cover decreases rapidly as juniper dominance increases today (Miller et al. 2000 in Heyerdahl et al. in press).

Nearly all sagebrush communities today have been grazed and there are no refugia to use as reference conditions.

Some grassland systems are invaded by sagebrush today in larger quantities. These grassland systems might today have mountain big sage, and pre-European, might have had a bit of mountain sage. In pre-European times they would have been grassland systems, whereas today they might be confused for mountain big sage systems. It might therefore be difficult to distinguish the early seral stages of this class from the grassland BpS 1139 system. It should be distinguished by elevational component.

Historically, this BpS in MZ21 was likely dominated by grassland such as that in succession class A along the forest ectonoe (Houston 1973; Arno and Gruel 1983). Since this type is largely interspersed with forest or occupies a narrow band adjacent to lower timberline, class A is likely to have dominated the landscape.

Mountain big sagebrush was probably not as abundant in presettlement conditions (Arno and Gruell 1983), since the original vegetation of sagebrush-grass consisted of a dense cover of perennial grasses among which were scattered moderate-sized shrubs. Sagebrush might be invading grasslands due to fire exclusion, overgrazing by livestock and/or climate change.

Fire exclusion is a major effect of livestock grazing in dynamic sagebrush/grassland systems (Miller et al. 1994; Miller and Rose 1999; Gruel 1999; Miller et al. 2000; Miller and Eddleman 2001; Crawford et al. 2004).

Furthermore, in MZ21, there are non-native species such as Phleum pratense, Cynoglossum officinale and many others.

Native Uncharacteristic Conditions

Shrub cover >45% cover or taller than one meter are uncharacteristic. Greater than 10% canopy cover by conifers can be considered uncharacteristic. Potential causes of encroachment include grazing and lack of fire, as well as climatic episodes favorable to tree regeneration.

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Scale Description

Fires burn in patchy mosaics in this type, and scales ranged from small (tens of acres) to very large (possibly hundreds of thousands of acres).

In MZ21, occurences are on the scale of 10s to 100s of acres, as opposed to other mapzones, where landscape-scale assessments could be in the order of 10000ac for mountain sagebrush steppe communities because of the mosaic nature of vegetation communities, the moderate to long fire mean return intervals, and the extent of the vegetation community.

On the widely distributed loamy soils, prior to 1900, sagebrush might have been restricted to small patches or widely spaced plants (Arno and Gruell 1983).

Issues/Problems

There is a limited amount of information available on fire regimes and reference conditions in sagebrush due to modern overgrazing (the herbaceous component is severely impacted and current information cannot exclude the effects of cattle). Nearly all sagebrush communities today have been grazed - there are few known refugia to use as reference conditions.

Comments

The model for MZ20 was adopted as-is from the model in MZ21.

This model for MZ21 is based on the LANDFIRE model for the same BpS 1126 for MZs 10 and 19, created by Kathy Geier-Hayes (kgeierhayes@fs.fed.us), Steve Rust (srust@idfg.idaho.gov) and Susan Miller (smiller03@fs.fed.us), reviewed by Dana Perkins (dana_perkins@blm.gov), Carly Gibson (cgibson@fs.fed.us) and Mary Manning (mmanning@fs.fed.us). Original modelers for MZ21 were Tim Klukas (tim_klukas@nps.gov), Reggie Clark (rmclark@fs.fed.us), John Simons (john_simons@blm.gov) and one anonymous contributor. Additional reviewers for MZ21 were Stan Kitchen (skitchen@fs.fed.us) and Brenda Fiddick. After an extensive model review process, and LF leadership guidance, a different methodological approach to interpreting and modeling sagebrush systems will be used. Original MZ21 model was altered to reflect majority opinion/literature regarding fire regime, and the model was therefore changed to reflect methodology and interpretation reflected in the majority of literature and consistent with majority expert opinion.

For MZs 10 and 19, modifications were made to the structural data to adhere to LANDFIRE standards (Pohl 11/14/2005).

For MZs 10 and 19, this BpS was adapted from the Rapid Assessment model R0SBMT (Mountain Sagebrush) by Mark Williams and reviewed by Bill Baker (bakerwl@uwyo.edu), Dennis Knight (dhknight@uwyo.edu), Ken Stinson (ken_stinston@blm.gov), Thor Stevenson (thor_stephenson@blm.gov), Gavin Lovell (gavin_lovell@blm.gov), Curt Yanish (curt_yanish@blm.gov) and Eve Warren (eve_warren@blm.gov).

For the Rapid Assessment, this model combined two additional Rapid Assessment models after peer-review: R0MTSBsb (workshop code MSHB2), modeled by Diane Abendroth (Diane_Abendroth@nps.gov) and reviewed by Dennis Knight (dhknight@uwyo.edu), Don Bedunah (bedunah@forestry.umt.edu), Shannon Downey (shannon_downey@blm.gov), Bill Baker (bakerwl@uwyo.edu), Ken Stinson (ken_stinson@blm.gov), Thor Stephenson (thor_stephenson@blm.gov), Curt Yanish (curt_yanish@blm.gov), Gavin Lovell (gavin_lovell@blm.gov); and R0SBCL (workshop code CSAG1) modeled by George Soehn (george_soehn@blm.gov) and reviewed by Eldon Rash (erash@fs.fed.us) and

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Reggie Clark (rmclark@fs.fed.us).

Rapid Assessment peer review suggested lumping R0SBMT with R0MTSBsb as their disturbance regimes and vegetation composition were nearly identical. R0SBMT was very different from the model, R0SBCL in fire regime, but the other characteristics were the same. Based on the abundant peer review for R0SBMT, R0SBCL was combined here. Reviewers during RA disagreed about the range of fire frequency for this vegetation type, suggesting MFIs ranging from 25-135yrs. The model was originally developed with an MFI of 50yrs; based on peer review it was increased to 70yrs during the RA. See RA models for resulting changes.

Vegetation Classes

Class A 25 %

Early Development 1 All Structures

Upper Layer Lifeform

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

Fuel Model 1

Indicator Species* and Canopy Position

FEID	Lower
PSSP6	Lower
Forbs	Lower
ARTRV	Lower

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0 %	30 %
Height	Herb 0m	Herb 0.5m
Tree Size Class	None	

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

As per new instruction from MFSL, dominant lifeform is indicated in drop-down boxes, not upper layer. Grasses and forbs are the dominant lifeform in this class. They have a cover between 0-30% with a height of between 0-0.5 meters. Shrubs are the upper-layer lifeform and have <10% cover, as this class is dominated by grasses and recovering early shrubs.

Description

Shrub cover is low, and typically ranges from 0-10%. Five percent shrub cover indicates good establishment of a post-fire cohort. Herbaceous cover is variable, but is typically at least 30%. This class lasts approximately 13yrs, and then succeeds to mid-development open (class B).

Historically, this BpS in MZ21 was likely dominated by grassland such as that in class A along the forest ectonoe (Houston 1973; Arno and Gruel 1983). Since this type is largely interspersed with forest or occupies a narrow band adjacent to lower timberline, class A is likely to have dominated the landscape.

Replacement fire occurs at approximately every 50yrs.

Grazing occurs, but modeled infrequently (.002 probability).

In this environment (and a number of the other grassland, shrub steppe types) forb density and cover are most responsive to climatic conditions. Hence fire response will vary according to precipitation patterns before and immediately after the fire. Grasses are less “ephemeral” and tend to respond to the fire directly. That’s why we elected to not identify specific forb species response.

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Class B 45 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 6

Indicator Species* and Canopy Position

ARTRV	Upper
FEID	Lower
PSSP6	Lower
ARTR4	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	30 %
Height	Shrub 0m	Shrub 1.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

(This class would also include shrubs > 0.5m tall but <25% cover.)

Description

Shrub cover is <25%. Reaching 20% sagebrush cover following a stand-replacing fire takes between 10-33yrs (Tart, personal correspondence).

There is a 40% herbaceous canopy cover across this class.

Replacement fire causes transition to A every 50yrs, while insects (0.005 probability) and drought (100yrs), and native grazing (0.002 probability) may thin the stand, but maintain it in class B.

This class transitions to a late closed state after 30-40yrs.

Herbaceous cover is variable in this class. Native grazing on winter ranges by elk and deer typically may decrease sagebrush cover but doesn't cause a transition to another class. Insects and drought may occur but don't cause a transition to another class.

Purshia tridentata may be present.

Class C 30 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 2

Indicator Species* and Canopy Position

ARTRV	Upper
PSSP6	Lower
FEID	Lower
ARTR4	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	50 %
Height	Shrub 0m	Shrub 1.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Sagebrush cover is from 26-45%. Sagebrush cover rarely exceeds 40% cover, and over 45% cover would be uncharacteristic. Mountain big sagebrush canopy cover is constrained by competition from herbaceous vegetation on all but the wettest sites (Tart 1996). Competition between herbs and sagebrush is less pronounced on cooler, wetter sites. High canopy cover of mountain big sage only develops after removal of herbaceous vegetation. Some researchers believe that mountain big sagebrush can never exceed 25% cover (Pedersen et al. 2003) Understory vegetation has low cover in this class.

Insects (75yrs) and drought stress (100yrs) cause transitions to class B by thinning sagebrush cover every 50-100yrs. If no disturbance occurs, this condition can persist.

Native grazing occurs (0.002 probability), but maintains the stand.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Purshia tridentata may be present.

Replacement fire occurs every approximately 50yrs.

Class D **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Class E **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Disturbances

Fire Regime Group:** **IV**

Historical Fire Size (acres)

Avg 0
Min 0
Max 0

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	50	30	200	0.02	100
Mixed					
Surface					
All Fires	50			0.02002	

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

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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**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.

NY.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011270 Inter-Mountain Basins Semi-Desert Shrub-Steppe

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

General Information

Contributors (also see the Comments field) **Date** 11/18/2005

Modeler 1	Don Major	dmajor@tnc.org	**Reviewer**	Mike Zielinski	mike_zielinski@nv.blm.gov
Modeler 2	Louis Provencher	lprovencher@tnc.org	**Reviewer**	Terri Barton	terri_barton@nv.blm.gov
Modeler 3			**Reviewer**		

Vegetation Type

Upland Savannah/Shrub Steppe

Map Zone

20

Model Zone

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

Dominant Species*

GRSP
TETRA3
ARTRW
ATCO

General Model Sources

☐ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range

This ecological system occurs throughout the intermountain western US.

Biophysical Site Description

Found at elevations ranging from 4000-5000ft. The climate where this system occurs is generally hot in summers and cold in winters with low annual precipitation, ranging from 5-10in and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variation. Sites are generally alluvial fans and flats with moderate to deep soils. Substrates are generally calcareous derived from alluvium, medium to coarse-textured alluvial soils. Soils may be alkaline and typically moderately saline (West 1983).

This group generally lies above salt desert shrub and below sagebrush types. Both to the north and up slope it is bordered by low elevation big sagebrush groups, commonly ARTRWY, ARAR8 and ARNO4 communities. To the south this group is bordered by Mojave Desert transition communities.

Vegetation Description

The plant associations in this system are characterized by a somewhat sparse to moderately dense (10-70% cover) shrub layer of Grayia spinosa, Artemesia tridentata, Ephedra nevadensis, Ephedra viridis, Chrysothamnus viscidiflorus, Sarcobatus vermiculatus or Atriplex canescens. Shrub Tetradymia canescens may be occasionally present. The herbaceous layer is dominated by bunch grasses which occupy patches in the shrub matrix. The most widespread species is Heterostipa comata and Achnatherum hyminoides. Other locally dominant or important species include Leymus cinereus, Pascopyrum smithii, Pleuraphis jamesii, Elymus lanceolatus, Elymus elymoides, Koeleria macrantha, Hesperostipa comata and Poa secunda. Forbs

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**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.

are generally of low importance and are highly variable across the range, but may be diverse in some occurrences. Species that often occur are Astragalus, Oenothera, Eriogonum and Balsamorhiza. Mosses and lichens may be important ground cover.

Disturbance Description

Disturbance is unpredictable in these systems. However, drought insects and fire may all occur here. Drought periods occurred approximately every 75yrs.

Documented Mormon cricket/grasshopper outbreaks since settlement have corresponded with drought; outbreaks cause shifts in composition amongst dominant species, but do not typically cause shifts to different seral stages. Therefore insect disturbance was not modeled. During outbreaks Mormon crickets prefer open, low plant communities. Herbaceous communities and the herbaceous component of mixed communities were more susceptible to cricket grazing.

Fire was infrequent and somewhat dependent on fire importation from the upper sagebrush zone. Replacement fire was the primary fire with mean FRI (200-300yrs) increasing with shrub development intermixed with grass.

Adjacency or Identification Concerns

This BpS is transitional between salt desert shrub (1081) and Inter-Mountain Basins Big Sagebrush Shrublands (1080) and is truly considered a higher elevation type of salt desert shrublands. Intermingling of both ecological systems on different lifeforms and aspects on alluvial fans creates this BpS.

This ecological system contains the typical Great Basin salt desert shrub communities. Salt desert shrub is also common in the Wyoming big sagebrush community and there is some species overlap. A wide range of salt desert shrubs can occur in this group.

Indian ricegrass can dominate sites with sand sheets, or surfaces, however, the temporal nature of this condition is unknown.

Upland shrub communities are easily invaded and, in the short term at least, replaced by cheatgrass. Other nonnative problematic annuals include halogeton, Russian thistle and several mustards. Through central UT and east central NV this group is susceptible to invasion by squarrose knapweed. More mesic areas can be invaded by tall whitetop and hoary cress. All three are noxious weeds in Great Basin states.

Native Uncharacteristic Conditions

Scale Description

Grayia spinosa communities occupy a narrow elevation band that can be extensive in many valleys (>10000ac). Disturbance scale was variable during presettlement. Droughts and extended wet periods could be region wide, or more local. A series of high water years or drought could affect whole basins.

Most fires were rare and less than 1ac, but may have exceeded hundreds of acres with a good grass crop.

Issues/Problems

Comments

For MZ20, this BpS was adopted as-is by MFSL from MZ19.

For MZ19 - This model is identical to the model from MZ18 with minor modifications to the description.

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**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.

Originally, BpS 1127 for MZs 12 and 17 was based on the model results for BpS 1081 (salt desert shrub) developed by Gary Medlyn (gmedlyn@nv.blm.gov) and Don Major (dmajor@tnc.org) because 1127 and 1081 are both salt desert shrub systems. Reviewers recommended significant changes to the description and model to adapt this model to the spiny hopsage ecological site description. Spiny hopsage, a salt desert species, does not respond to drought and extended wet periods as does shadscale (BpS 1081). Moreover, spiny hopsage communities support a higher cover of Indian ricegrass than shadscale (little grass cover) and contain Wyoming and basin big sagebrushes. Therefore, class C was removed from the model, MFRIs shortened and the explicit effect of wet extended periods removed from the model. Descriptions for 1127 are from NatureServe and modified according to the NRCS ecological site descriptions for spiny hopsage. Annie Brown (annie_brown@blm.gov), Jolie Pollet (jpollet@blm.gov) and Stanley Kitchen (skitchen@fs.fed.us) developed 1081 for MZ16, which was based on PNVG R2SDSH from the Great Basin Rapid Assessment. Greasewood box was removed from R2SDSH by Jolie Pollet, Annie Brown and Stanley Kitchen to build this model. Model was greatly simplified at that time. Original descriptions by Bill Dragt were kept. Reviewers of R2SDSH were Stanley Kitchen (skitchen@fs.fed.us), Mike Zielinski (mike_zielinski@nv.blm.gov) and Jolie Pollet (jpollet@blm.gov).

This model was imported from MZ19 by Brendan Ward.

Vegetation Classes

Class A 30 %

Early Development 1 All Structures

Upper Layer Lifeform

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

Fuel Model 1

Indicator Species* and Canopy Position

ACHY	Mid-Upper
HECO26	Upper
GRSP	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	10 %
Height	Herb 0m	Herb 0.5m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

Dominated by continuous Indian ricegrass with widely scattered shrubs and relatively younger shrubs than in class B . Over 20yrs, vegetation moves to class B. Replacement fire occurs every 200yrs on average, and will set back succession to year zero. Climate (every 75yrs) will also have a stand replacing effect.

Class B 70 %

Mid Development 1 Open

Upper Layer Lifeform

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

Fuel Model 2

Indicator Species* and Canopy Position

GRSP	Upper
ARTR2	Upper
ACHY	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	30 %
Height	Shrub 0m	Shrub 1.0m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

Discontinuous grass patches, and higher shrub canopy cover than in class A. Spiny hopsage dominates. Climate (every 75yrs) will shift vegetation back to class A. Replacement fire is infrequent (mean FRI of 200yrs).

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Class C **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Class D **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Class E **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Disturbances

Fire Regime Group:** **V**

Historical Fire Size (acres)

Avg 10
Min 1
Max 1000

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	227	100	500	0.00441	100
Mixed					
Surface					
All Fires	227			0.00443	

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

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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Hironaka, M., M.A. Fosberg, and A.H. Winward. 1983. Sagebrush-grass habitat types of southern Idaho. Forestry, Wildlife, and Range Experiment Station Bulletin No. 15, University of Idaho, Moscow. 44 pp.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011390 Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland

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

General Information

Contributors (also see the Comments field) **Date** 6/8/2006

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Modeler 2			**Reviewer**	Steve Barrett	sbarrett@mtdig.net
Modeler 3			**Reviewer**	Mary Manning	mmanning@fs.fed.us

Vegetation Type

Upland Grassland/Herbaceous

Map Zone

20

Model Zone

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

Dominant Species*

PSSP6	LEKI2
FEID	SCHIZ4
FECA4	ELMA7
ACNE9	ELTR7

General Model Sources

☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

Northern Rockies throughout MT, northern ID. May occupy river valleys, including the Salmon, Snake and Clearwater Rivers. Drier portions of this type will resemble bluebunch wheatgrass communities in Columbia Basin.

In MZ20, this system occurs along the western and southern borders, in NRCS's MLRA-46 Northern Rocky Mountain Foothills. - in subsections 331Da, 331Kj, eastern portion of 331Kh

Biophysical Site Description

This type occupies productive uplands below lower treeline or in small pockets where cold air drainage or shallow soils inhibit conifer growth, generally ranging from 1000-5000ft. In MZ20, elevation would be approximately 2200-5000ft.

Elevation and aspect affect the precipitation and temperature, due to changes in foothills slopes.

Vegetation Description

This type is dominated by rough fescue or bluebunch wheatgrass with Idaho fescue as a less dominant in MZ20 and rough fescue as dominant associates. Bluebunch wheatgrass is more prevalent in drier areas. When dominated by bluebunch wheatgrass, not as much canopy. Mueggler and Stewart (1980) have described these types as: Agsp/Posa, FEID/Agsp and Fesc/Agsp. Additional species include needle and thread, Sandberg bluegrass and a variety of mesic forbs (eg, showy cinquefoil, sticky geranium, phlox, lupine and yarrow). In MZ20, very little phlox, needle-and-thread and Sandberg bluegrass. In MZ20, more stoneseed.

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**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.

For MZ20, additional species include Columbia needlegrass, green needlegrass, slender wheatgrass or thickspike wheatgrass and little bluestem. More spike fescue in southern area near M332Dc. North end has rough fescue (around subsections 331Da, parts of 331Kh,I,j), but central and south don't have rough fescue. Central and south still have bluebunch and Idaho fescue (as does north).

Disturbance Description

This type has frequent replacement fires (fire regime group II). Most species in this type are fire adapted and respond favorably to these fire types.

Where these systems occur near forested ecosystems, fire frequency will be strongly influenced by the adjacent forest's fire regime (eg, 10-20yrs). Where these systems occur below lower treeline, fire frequencies may be longer (eg, 20-30yrs), for an overall average of between 10-30yrs. The literature in FEIS suggests a MFI of between 10-30yrs for this type.

It is thought that there could have been Native American fire influence in many valleys and therefore FRI might be approximately 15yrs. However, it was modeled at 20yrs.

Bison impact was prominent in the late fall and summer periods, depending on precipitation patterns.

Mormon crickets, grasshoppers might have had more of an impact in this system than currently defined, but unsure of historic impact and frequency. Therefore, this was not modeled.

Drought also occurs in this BpS. Drought probably occurs less frequently than in BpS 1141 due to more consistent precipitation patterns, more snow, higher elevation.

Adjacency or Identification Concerns

This variant of the BpS for MZ20 is different from the other mapzones - ie, MZ19, as plant species differ and precip. Since this is a broad type, the dry bluebunch wheatgrass-needle and thread variant (in MZ20 it's a bluebunch wheatgrass-thickspike wheatgrass variant) will probably have more bareground and a slightly higher MFI. Response to fire may differ slightly also, as needle-and-thread is more sensitive to fire.

Non-native species present today can include spotted knapweed, leafy spurge, Japanese brome, kentucky and canada bluegrass, timothy, smooth brome and hounds tongue.

Without fire and poor grazing management today, creeping juniper can invade this BpS.

Native Uncharacteristic Conditions

Unlikely to see bare ground in this BpS. Although herbaceous cover might not exceed 50%, the remainder is litter and/or rocks.

Scale Description

This type can occupy broad expanses and also narrow bands below the lower montane forest. In large valleys, fires may have been expansive historically, up to thousands of acres. In MZ20, there are no large valleys.

Issues/Problems

This is a highly variable type, which includes most of Mueggler and Stewart's habitat types. The Lewis and Clark range type classification needs to be incorporated into this model also.

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**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.

Comments

This model for MZ20 was adapted from the model from the same BpS for MZ19 created by Katie Phillips, Randall Walker, Larry Kaiser and reviewed by Lois Olsen. For MZ20, descriptive and model additions and changes were made to better represent MZ20.

The model for MZs 10 and 19 are based on Rapid Assessment model R0MGRA by Mary Manning (mmanning@fs.fed.us) and reviewed by Eldon Rash (erash@fs.fed.us).

Vegetation Classes

Class A **15%**

Early Development 1 Open

Upper Layer Lifeform

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

Fuel Model

Description

Indicator Species* and Canopy Position

FECA4	Upper
PSSP6	Upper
ACNE9	Mid-Upper
LEKI2	Low-Mid

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0%	20%
Height	Herb 0m	Herb 0.5m
Tree Size Class	None	

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

Shrubs might be present at 0-5% in some areas. Shrub species may include Potentilla freticosa, Artemisia tridentada (mountain big sagebrush supspecies), Symphorocarpus, fringed sagewort and mountain silver sagebrush (Artemisia cana). On shallow, silty sites, shrubs such as skunkbush sumac, creeping juniper and yucca are present.

Post fire, early seral community dominated by bunchgrasses and forbs. Herbs and forbs will generally have higher cover than pre-burn and may include astragalus, balsamroot, lupines, yarrow and Thermopsis rhombifolia. Wild onion might also come in after fire.

This was originally modeled as a three-box model with a mid-development stage. However, it was changed to a two-box model, combining B and C, as it was suggested that recovery would be quick and could recover fully after three years with no mid-development stage. Therefore, there would be 0-20% cover from 1-3yrs, but after three years, 21-50% cover. It is thought that class percentages would be 10% in A and the rest in the late stage, B.

Cover ranges from 0-20%. In the absence of fire or heavy animal impact, this condition succeeds to a mid-late-development condition (class B). Age ranges from 0-3yrs. Idaho fescue may be present, but will recover more slowly than the bluebunch wheatgrass after fire. Idaho fescue might suffer mortality during the fire.

Drought affects seven percent of the class each year (occurs every 15yrs throughout class). Grazing affects 20% of the class each year (occurs every five years throughout class).

Replacement fire occurs every 20yrs.

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**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.

Class B **85%**

Mid Development 1 Closed

Upper Layer Lifeform

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

Fuel Model

Description

Indicator Species* and Canopy Position

FECA4	Upper
PSSP6	Upper
FEID	Low-Mid
LEKI2	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	50 %
Height	Herb 0m	Herb 1.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Bunchgrasses dominate with low densities of shrubs (10-15%) in some areas, particularly where this BpS transitions to shrub or tree-dominated communities. Shrubs might be present at 5-15% in some areas. Shrub species may include Potentilla freticosa, Artemisia tridentada (mountain big sagebrush supspecies), Symphorocarpus, fringed sagewort and mountain silver sagebrush (Artemisia cana). On shallow, silty sites, shrubs such as skunkbush sumac, creeping juniper and yucca are present.

Mid-late-development with moderate canopy closure dominated by bunchgrasses with forb cover generally higher than pre-burn. Typically lasts five years in a mid-stage, then moves to the final late stage. The late development stage has a closed canopy of grasses and forbs. Bunchgrasses dominate with low densities of shrubs (<15%) in some areas, particularly where this BpS transitions to shrub or tree-dominated communities. Shrub species may include Potentilla freticosa, Artemisia tridentada (mountain big sagebrush supspecies), Symphorocarpus, fringed sagewort and mountain silver sagebrush (Artemisia cana). On shallow, silty sites, shrubs such as skunkbush sumac, creeping juniper and yucca are present.

Typically, cover doesn't get much higher than 50% cover. Maximum height usually reaches approximately 0.75m.

Drought affects 7% of the class each year (occurs every 15yrs throughout class). Grazing affects 20% of the class each year (occurs every five years throughout class).

Replacement fire occurs every 20yrs.

Class C **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model

Description

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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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:** **II**

Historical Fire Size (acres)

Avg 0
Min 0
Max 0

Sources of Fire Regime Data

☑ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	20	2	30	0.05	100
Mixed					
Surface					
All Fires	20			0.05002	

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

References

Agee, J.K. 1994. Fire and weather disturbances in terrestrial ecosystems of the eastern Cascades. From Hessburg, Paul, ed. Volume III: Assessment. Eastside Forest Ecosystem Health Assessment. USDA Forest Service Pacific Northwest Research Station General Technical Report PNW-GTR-320.

Daubenmire, R.F. and J.B. Daubenmire. 1968. Forest vegetation of eastern Washington and northern Idaho. Technical Bulletin 60. Pullman, WA: Washington State University, Agricultural Experiment Station. 104 pp.

Mueggler, W. F. and W. L. Stewart. 1980. Grassland and Shrubland habitat types of Western Montana. USDA GTR INT-66.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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USDA-NRCS. 2003. eFOTG: Electronic Field Office Technical Guide. Available at: http://www.nrcs.usda.gov/technical/efotg/.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011400 Northern Rocky Mountain Subalpine-Upper Montane Grassland

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

General Information

Contributors (also see the Comments field) **Date** 11/6/2006

Modeler 1	Steve Barrett	sbarrett@mtdig.net	**Reviewer**	Jon Siddoway	jon.siddoway@mt.usda.gov
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Modeler 3	Randall Walker	rmwalker@fs.fed.us	**Reviewer**	Mary Manning	mmanning@fs.fed.us

Vegetation Type

Upland Grassland/Herbaceous

Map Zone

20

Model Zone

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

Dominant Species*

FECA4	ACRI8
FEID	KOMA
ASTER	TRSP2
ERIOG	BASA3

General Model Sources

☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

Northern ID, western MT and eastern WA. In MZ20, this system is very limited in extent.

In MZ20, this probably only occurs in some of the more mountainous areas - ie, MLRA 43B Central Rocky Mountains, which corresponds to subsection M332Db, and just below Havre in 331Ka. This BpS might also be just creeping into MZ20 from the corners of MZ19, on the southwest corner of MZ20.

Biophysical Site Description

This is a high-elevation (>6000ft), dry grassland system dominated by perennial grasses and forbs, on dry sites particularly south-facing slopes. Subalpine grasslands are small meadows to large open parks surrounded by conifer trees but lack tree cover within them. In general soil textures are much finer, and soils are often deeper under grasslands than in the neighboring forests. Sites are often wind-swept, resulting in lack of snowpack and summer drought (Daubenmire 1981).

Vegetation Description

Typical dominant species include Festuca viridula (not in MZ20), Festuca idahoensis, Aster spp, Eriogonum spp, Lupinus spp and Xerophyllum tenax. Rough fescue is present in MZ20. Bluebunch also wouldn't be present in MZ20 - would occur on much drier slopes. Would have Richardson's needlegrass, western needlegrass and Letterman's needlegrass. Also in MZ20 - Balsamorhiza sagittata, Bromus marginatus, Carex spp, Geranium viscossimum and Geum triforum (mesic forbs).

Disturbance Description

Fire regimes are probably similar to adjacent forested vegetation, and will generally be long interval, stand replacement regimes (Fire Regime Group IV). Fires may finger into this system from adjacent forests.

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However, fire scarred lodgepole pine and other species with MFIs of 20-30yrs are commonly encountered; lightning may well have provided more opportunity in this flammable type than in adjacent forest, plus Indian fire use likely occurred in some areas for management of campsites, travel zones, hunting areas and horse grazing purposes.

There is some question as to whether this should have a shorter fire return interval. However, other mapzones modeled this system with a long FRI, it is a high elevation system with few trees and it is described by NatureServe as "upper montane to subalpine, high-elevation, lush grassland system dominated by perennial grasses and forbs on dry sites… subalpine dry grasslands…" However, the low end of the MFI range could go as low as 40yrs, given the inclusion of dry low-elevation grasses in this model, but the inclusion of moist-high elevation XETE definitely argues for a higher MFI; so an overall 75yrs MFI was chosen for MZ20. This 75yrs MFI is similar to the MFI chosen for MZ20's 1145 as well, since the range could vary greatly and due to both of the systems' ambiguous descriptions.

Conifer encroachment is not common due to the drought nature of these grasslands, but undoubtedly fire also plays some role in preventing conifer encroachment. This system is a climatic climax - site maintained grassland system.

Historically, sheep grazing probably occurred more frequently than currently.

Adjacency or Identification Concerns

Historical sheep grazing may have occurred in these systems. The cumulative effects are unknown.

Current grazing is by cattle.

Timothy is a prominent invader in this system in MZ20.

Native Uncharacteristic Conditions

Scale Description

Patches are typically tens to hundreds of acres.

Issues/Problems

Comments

This model for MZ20 was adapted from the same BpS from MZ19 created by Katie Phillips, Randall Walker and Larry Kaiser. Quantitative and descriptive changes were made to better fit the concept of this BpS, esp for NCR; original modelers' names were still retained, as they created most of the model. For MZ20, descriptive additions and changes were made to better reflect MZ20 sites. Descriptive changes were made, including dominant species changes. Two of the original modelers' names were retained, as most of the model was theirs (at request of MZ20 modeler).

For MZs 10 and 19, this model received no peer review.

Vegetation Classes

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Class A 5%

Early Development 1 All Structures

Upper Layer Lifeform

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

Fuel Model 0

Indicator Species* and Canopy Position

FECA4	Upper
FEID	Upper
ACOC3	Upper
BASA	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	30%
Height	Herb 0m	Herb 1.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Post-replacement disturbance conditions dominated by herbs and sprouting grasses including green fescue (not in MZ20), Idaho fescue, bluebunch wheatgrass (not in MZ20), Xerophyllum tenax (not in MZ20) or Epilobium spp.

In MZ20, rough fescue would be present.

This class succeeds to a late-development stage, class B, in four years.

Class B 95%

Late Development 1 Closed

Upper Layer Lifeform

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

Fuel Model 0

Indicator Species* and Canopy Position

FECA4	Upper
FEID	Upper
ACOC3	Upper
BASA	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31%	100%
Height	Herb 0m	Herb 1.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Closed herbaceous cover dominated by green fescue (not in MZ20), Idaho fescue, bluebunch wheatgrass (not in MZ20) and Xerophyllum tenax (not in MZ20). Low shrubs may be present, particularly mountain big sagebrush, Erigonum spp and Phlox spp.

In MZ20, Rough fescue would be present.

Replacement fire occurs every 75yrs.

Class C 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 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 20
Min 1
Max 100

Sources of Fire Regime Data

☑ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	75	40	200	0.01333	100
Mixed					
Surface					
All Fires	75			0.01335	

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

References

Daubenmire, R. 1981. Subalpine parks associated with snow transfer in the mountains of northern Idaho and eastern Washington. Northwest Science. 55(2): 124-135.

Daubenmire, R.F. and J.B. Daubenmire. 1968. Forest vegetation of eastern Washington and northern Idaho. Technical Bulletin 60. Pullman, WA: Washington State University, Agricultural Experiment Station. 104 pp.

Franklin, J.F. and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. Gen. Tech. Rep. PNW-8. Portland, OR: USDA Forest Service, Pacific Northwest Forest and Range Experiment Station. 417 pp.

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**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.

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

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**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011410 Northwestern Great Plains Mixedgrass Prairie

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

General Information

Contributors (also see the Comments field) **Date** 4/6/2006

Modeler 1	Shannon Downey	sdowney@blm.gov	**Reviewer**	Steve VanFossen	Steve.VanFossen@mt.usda.gov
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Modeler 3	Jeff DiBenedetto	jdibenedetto@fs.fed.us	**Reviewer**	Jon Siddoway	jon.siddoway@mt.usda.gov

Vegetation Type
Upland Grassland/Herbaceous

Map Zone
20

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

Dominant Species*
PSSP6 SCSC
NAVI4 KOMA
PASM POSE
HECOC8 BOGR2

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

This vegetation group covers the northern prairies east of the Rocky Mountains from north central MT to southeastern MT and northeastern WY.

This BpS occurs in every section throughout the MZ20. It occurs predominantly in subsections 331Dh (central and eastern portion) and 331La.

Subsection 331La coincides quite closely to the Brown Central Glaciated Plains MLRA52, as defined by the NRCS. The central and eastern part of 331Dh coincides with Northern Glaciated Plains MLRA. Also - MLRA 58a includes southeastern MT. This BpS also resides in MLRA53A Northern Dark Brown Glaciated Plains, Northern Rolling High Plains, MLRAs 58A,B,C,D, and Pierre Shale Plains, MLRAs 60A and 60B.

This system's extent also coincides with EPA Ecoregions Level III and IV, 42-Northern Glaciated Plains, 43n-Montana Central Grasslands, 43m-Judith Basin Grasslands, 43o-Montana Unglaciated high Plains and 43a-Missouri High Plateau (Woods et al 2002).

Historically, this BpS could also have extended throughout the subsections for 331Kb,most of d,f and e; presently, it might be more of a shrub community.

This BpS occurs in every subsection throughout the MZs 29 and 30. It occurs predominantly depending on soil types and precipitation zones. It typically does not occur within mountain subsections.

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Biophysical Site Description

Elevations range from 1900-4000ft, or up to 6500ft in MZ29. The continental climate entails long cold winters, hot summers with low humidity and strong winds between November through April.

The northwestern part of this BpS is characterized by Chinook winds in winter commonly resulting in "red belt mortality" in adjacent coniferous forests (Van Fossen, pers comm).

Mean annual precipitation is generally 10-15in with most falling as rain or snow from April through June. The western part of this BpS is characterized by C3-cool-season plants and the eastern part of the BpS has an increase in abundance of C4-warm season plants, almost to the point of dominance in the plant community.

Occurs ubiquitously across soil types, except alkaline flats. Kinds, amounts and proportions of plants vary widely relative to soil texture, soil depth, percent slope and aspect. Bunchgrass communities dominate on shallow soils. Mid, short and bunchgrass communities comprise the remainder.

Topography is level to sloping.

Reviewers of this model (B.J. Rhodes, Bill Volk and John Carlson) for MZ20 stated that this system resides in the soil survey studies done by NRCS, and that their original modeling for this effort relied heavily on the Ecological Site Descriptions for MLRA 52 (NRCS 2004), 5i8A and 60B (NRCS 2003). However, MLRA 52 is dominantly deep, well drained clay loam, clay and loam textures, whereas MLRA 58A and 60B have a significant component of moderately deep and shallow silt loam, silty clay loam and loam soils (Van Fossen, pers comm). It has been suggested by one reviewer that Glaciated Plains be separated from Northern Rolling High Plains. However, this model was not split as such.

Vegetation Description

The vegetation is dominated by cool and warm season perennial grasses (50-85% canopy cover). Gramma grasses, rhizomatous grasses (western and thickspike wheatgrass, etc.) dominate the visual aspect of the community, though bunch grasses (bluebunch wheatgrass, bluebunches, needle grasses, etc.) often comprised more than 50% of the community composition. Thickspike wheatgrass (Elymus macrourus) (on lighter soils) is also present and usually western wheatgrass (on heavier soils). CALO can also be a dominant species. Idaho fescue is a community dominant in MZ29 where precipitation is greater than 17in (Ashland Ranger District). Prairie sandreed and upland sedges occupy sandy textured soils throughout MZs 29 and 30. Bluebunch wheatgrass is more prevalent within WY and eastern MT in MZ29.

Carex filifolia also present, but not that prominent.

A diverse array of perennial summer forbs (black samson, scurfpea, prairieclovers, flax, dotted gayfeather, scarlet globemallow, etc.) occupies 10% of the community.

Shrubs and halfshrubs (Wyoming big sagebrush, silver sagebrush, rabbit brush, fringed sagewort, western snowberry, etc.) obtain less than five percent cover. Most of the ground surface is covered and bare ground is <10% on more mesic sites and 20% on more xeric sites (eg, glacial till and claypand soils).

The most common shrub is silver sagebrush, which resprouts after fire.

In pre-Euro conditions, there was a component of this BpS that had significant prairie dog impact and was characterized by broom snakeweed, prairie sagewort, sixweeks fescue and plains pricklypear.

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Current conditions are different - please see Identification Concerns or Issues/Problems boxes.

Disturbance Description

Grazing by large, concentrated herds of ungulates (bison, elk, pronghorn and deer) along with aboriginal and natural fire maintained healthy, productive and diverse grasslands. (This grazing regime is referred to as "Native Grazing" in the VDDT model.) Such grazing may have resulted in heavy defoliation and/or some soil churning, but was transitory. Temporary impact followed by rest-recovery time is characteristic. A reviewer stated that ungulate grazing might have limited the potential for replacement fires at times, as there might have been significant areas that couldn't carry a fire for very long periods of time. However, this comment was not input into the model.

A small portion of the landscape was subjected to repeated or prolonged heavy animal impact, including heavy defoliation and repeated soil churning and/or compaction. Such areas included watering points for herds, bison or elk wallows and prairie dog towns. This heavy animal impact disturbance was modeled as "Optional2" in the VDDT model and includes its impacts in its own class. Repetitive heavy animal impact sends the community to an alternative open successional pathway. This small prairie-dog impacted portion of the landscape was also characterized by different grasses (see Vegetation Description).

Periodic grazing and replacement fire, when it occurred in an intact community, resulted in removal of most of the above-ground biomass, but resulted in little mortality and relatively rapid recovery times.

Because MLRA 52 versus MLRA 58A and 60B are physiographically different enough due to soils, etc., response to fire might change in different areas of the mapzone (VanFossen, pers comm).

Historically, the fire return interval averaged 8-12yrs for the region, but naturally occurring fuel breaks on slopes and badlands probably lengthened the mean interval. Grazing and prairie dog towns also reduced fuel loads and fire frequency, size and intensity; with the most substantial impacts in valley bottom shrublands and grasslands, and upland grasslands near water. Historically, the majority of human caused ignitions were concentrated in spring and fall seasons, while lightning-caused fires were concentrated in late summer. However, in the north central part of MT, in MZ20, lightning ignitions outside of the mountains are not primarily a late summer phenomenon, but rather, late spring and early to mid-summer phenomenon (not much happening after the end of July). Ignitions occur prior to green-up. If fall storms occur with lightning, those will also cause fires - and are often associated with heavy winds.

The absence of grazing and replacement fire for many years (e.g. 50yrs) would lead to an increased shrub component (snowberry and green ash) in precipitation zones greater than 14in, and a buildup of dead grass. Within 10-14in precipitation zones, Wyoming big sagebrush and silver sagebrush may also increase. Productivity of the grasses is decreased, resulting in greater mortality from smoldering fire.

Mormon crickets, grasshoppers and great plains locust might have had more of an impact in this system than currently defined, but unsure of historic impact and frequency (Siddoway).

Drought also occurs somewhat frequently. Some modelers felt it occurred every 30yrs, and some believed it occurred every five years. Short term precipitation variability may also influence species productivity.

Adjacency or Identification Concerns

Areas with similar soils but steeper topography (>15%) are less productive and have a higher dominance of shrubs.

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The natural grazing regime has been replaced with domestic livestock grazing that is targeted toward "moderate" grazing intensity. This is often characterized by grazing each year with removal of herbage over an extended period of the growing season without adequate rest and recovery from grazing. This is contrasted with the expected historic shorter, episodic grazing patterns. One result is more structural homogeneity. Under this grazing regime, taller, palatable grasses such as green needlegrass, bluebunch wheatgrass decrease and short grasses (western wheatgrass, needle and thread grass, blue gramma and sandberg bluegrass) increase. Only under season-long grazing will warm-season grasses like little bluestem decrease. Season of use and/or twice-over grazing will impact the prevalence of little bluestem and other C4 plants.

Shrubs (Wyoming sagebrush, silver sagebrush, western snowberry, rabbitbrush and fringed sagewort) increase greatly over the historic plant community. Compare to the ecological site description to avoid using a shrub model for historic plant community when considering a grass site that has changed as a result of uncharacteristic grazing or unnaturally long fire return intervals. Unnaturally long intervals without fire may contribute to an increased shrub component. Xeric sites will experience an increase in sagebrush, whereas western snowberry will increase in mesic areas.

In modern times, invasive grasses such as smooth brome (only in small areas), Poa pratensis, crested wheatgrass and Kentucky bluegrass (only in small areas) have become widely established in some areas and are locally abundant and expanding. Other invasive species of concern include spotted, diffuse and Russian knapweeds, often along roads and stream corridors; leafy spurge and Canadian thistle, along stream corridors; yellow sweetclover; dalmation toadflax; and annual bromes, including Japanese brome. Dense clubmoss stands are also a problem in this class, as is blue grama - limiting productivity and diversity in this system.

Long-term high intensity grazing by domestic livestock without periods of rest and recovery can result in a conversion in the vegetation states from a mid-grass dominated community to shortgrass dominated communities (blue grama, sedges, Sandberg's bluegrass, buffalograss in southern portions, and junegrass). This should be distinguished from the class (class B) that's influenced more by presence of prairie dog towns - which have a higher forb component with less of a mid-grass component than the other classes. In species composition, the prairie dog versus domestic grazed communities, are very different.

In current conditions, there has also been an increase in the amount of woody vegetation on the plains, particularly increases in snowberry on mesic sites and expansion of ponderosa pine into grasslands and shrublands which were probably maintained in a grassland state under historic fire frequencies. The lack of fire has shifted grassland systems to shrublands or woodlands.

This BpS may be similar to the PNVG R4PRMGn from the Northern Plains model zone. Reviewers (Rhodes, Volk and Adams) of this model felt that the Northern Great Plains shrubland might have been a subcomponent of this BpS that was historically limited to less productive soil types, and with a much longer fire cycle. However, other reviewers (VanFossen, pers comm) disagreed with that statement and stated that silver sagebrush, in particular, is and has been a natural component of deep, well-drained, productive soils.

In MZ20, historically, this BpS could also have extended throughout the subsections for 331K; presently, 331Kb, most of d, f and e might be more of a shrub community. Big sagebrush more susceptible to fire and so probably less prevalent historically.

Native Uncharacteristic Conditions

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**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

Historically, natural grazing and fire generally encompassed hundreds to hundreds of thousands of acres. Repeated heavy animal impact such as prairie dog towns occurred at the scale of 10s to 1000s of acres, as well as ungulate impacts - bison.

A negative exponential distribution probably best describes the historic fire size distribution, with a large number less than one hectare, median 10-100ha, mean 1000-10000ha, a low frequency of 50000-1000000ha and rare outliers >1000000ha (Henderson 2005).

Issues/Problems

This BpS covers a large diverse area with relatively little extensive data or published studies for vegetation classification. Fire frequency is based primarily on inference based on understanding of the plant community dynamics and anecdotes or historical research (mostly oral histories) regarding Indian burning.

Comments

Model for MZ20 was originally adapted from RA model R0PGRn created by Shannon Downey. Model for MZ20 was originally modeled with five boxes - by Shannon Downey and Steve Cooper. However, during a review session, reviewers (BJ Rhodes, John Carlson, Rich Adams and Bill Volk) suggested changes and changed this model to a three-box model. Agreement and input was received from the original modelers. Subsequent review of this model for an adjacent mapzone by modelers (Jeff DiBenedetto, Brian Martin, Cody Wienk, George Soehn and Bobby Baker) led to adoption of a different three-box model. After agreement from original modelers and reviewers, this last three-box model is the one that was used for MZ20. Because the original five-box and other three-box models originally developed, were abandoned, the details and the changes are not detailed here.

Other reviewers for this model for MZ20 were Steve Barrett, Mary Manning (USFS), Steve VanFossen (NRCS) and Jon Siddoway (NRCS).

Vegetation Classes

Class A 70 %

Early Development 1 All Structures

Upper Layer Lifeform

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

Fuel Model

Description

Indicator Species* and Canopy Position

PASM	Upper
NAVI4	Upper
HECO26	Upper
BOGR2	Lower

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0 %	60 %
Height	Herb 0.6m	Herb 1.0m
Tree Size Class	no data	

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

Shrub species could be present with approximately 0-10% cover. Common shrubs - silver sagebrush, winterfat, fringe sagewort and rubber rabbitbrush. Less common would be skunkbush sumac, mostly on slopes and shallow soils.

Class A represents the intact historic plant community functioning under grazing and/or fire, dominated by taller, cool and warm season rhihzomatous perennial grasses, as well as bunchgrasses. Little bluestem, prairie sandreed and bluebunch wheatgrass occur as dominant species in small patches. Other species in this class are Artemisia, grama grasses, western yarrow and prairie junegrass. Other species might include blue grama and

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western yarrow. STIPA, PSSP6 and SCSC might also be indicators.

Mappers - please note that the vegetation in this class can certainly be below 0.5m immediate post-fire-disturbance. However, because we had to distinguish this class from B - by something other than species (because species are certainly different in A/C vs B), we had to raise the height of the herbaceous cover in this class. Class B will have shorter vegetation.

Little below-ground mortality occurs after replacement fire, and resprouting of perennial grasses and forbs often occurs within days or weeks, depending on season. Grasses show greater vigor; some forb establishment may occur as a result of exposure of mineral soil. Canopy cover recovers quickly after resprouting. The community transitions to a mid-late-closed state (class C) within 15yrs.

Shrub species could be present at 0-10% cover. Silver sagebrush and winterfat are the most common shrub, and would start resprouting.

Club moss might be present on the Glaciated Plains at 0-5% cover, but not on shallow clay sites or dense clay sites, sands, saline upland, saline lowland, subirrigated or wet meadow.

Replacement fire occurs every 5-15yrs.

Drought occurs every 30yrs and maintains this stage. A reviewer felt that drought occurred more often, every five years, but because most wanted to model it at 30yrs, it was left as such.

Native grazing by large ungulates could have occurred, inlcuding bison grazing. It is likely heavy locally due to increased succulence of young grasses. It might occur with a probability of 0.2 (every five years, or 20% of this class each year).

Native grazing by prairie dogs could also occur on a small portion of the landscape (0.001 probability of 0.1% of this class), bringing this state to B.

Optional 1 was also modeled, which includes a combination of disturbances of drought, native bison grazing and a small amount of fire (not enough to be its own category). When all of these disturbances occur in concurrence, you might get a transition to the short-stature B-class type community. This occurs on a small portion of the landscape (0.001 probability of 0.1% of this class).

Insect/disease occurs very infrequently with a probability of 0.0001. It has been suggested that grasshoppers and Mormon crickets might have a larger impact historically than the probability assigned here. However, unsure of impact and frequency.

Class B **5%**

Mid Development 1 Open

Upper Layer Lifeform

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

Fuel Model

Description

Indicator Species* and Canopy Position

BOGR2	Upper
POSE	Upper
ARFR	Upper
DYPA	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	50 %
Height	Herb 0m	Herb 0.5m
Tree Size Class	no data	

☐ Upper layer lifeform differs from dominant lifeform.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
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Class B is very short-stature vegetation resulting from prairie dog disturbance or repeated high intensity herbivory or trampling (eg, watering points and buffalo wallows). This class may also be a short term response to severe drought, combined with other impacts (Optional 1 in class A). A variety of forb species such as fetid marigold, scarlet globemallow and curlycup gumweed tend to dominate this class. Common grass species include purple three-awn, buffalo grass, Sandberg bluegrass, blue grama and western wheatgrass. Fringed sagebrush can also be a component of this class. The fuel in this class are generally too sparse to carry fire.

Native grazing (bison, prognhorn and prairie dog) can be locally heavy due to increased succulence of young grasses. This occurs on 20% of this class each year, keeping it in this stage. This was split 50/50 between native grazing and Option 2.

(Note about identifying in current conditions: Long-term high intensity grazing by domestic livestock without periods of rest and recovery can result in a conversion in the vegetation states from a mid-grass dominated community to shortgrass dominated communities (blue grama, sedges, and sanders bluegrass, buffalograss in southern portions, and junegrass). This should be distinguished from this class B vegetative state that's influenced more by the presence of prairie dog towns - which have a higher forb component with less of a mid-grass component than class A or C. In species composition, the prairie dog versus domestic grazed communities are very different.)

Prairie dog disease could push this class to A. This was modeled with a frequency of every 100yrs or 1% of this class each year.

It is thought that this class should comprise approximately 5-8% of the landscape, and no more than 10% (Dan Uresk, pers comm). Research for historical Northwestern Great Plains vegetation would have prairie dog communities within an early successional stage of max 10-15% across an entire landscape. So only a portion of the early successional stage would be a prairie-dog-type community - ie, maybe 5-8%.

Class C 25%

Late Development 1 Closed

Upper Layer Lifeform

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

Fuel Model

Indicator Species* and Canopy Position

NAVI4	Upper
PASM	Upper
SYOC	Low-Mid
ARTR2	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	61%	90%
Height	Herb 0.6m	Herb 1.0m
Tree Size Class	no data	

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

Shrubs can be present at 20% cover. Common shrubs - silver sagebrush, winterfat, fringe sagewort, rubber rabbitbrush. Less common would be skunkbush sumac, mostly on slopes and shallow soils.

Description

This is a later successional community. Species composition is similar to class A. Shrubs are becoming more abundant. (The shrub component is not as strong in the Glaciated Plains, but rather in the Sedimentary Plains.) This represents the long-term class which has not been impacted by as much disturbance. It is at the upper-end of the fire interval. More litter is present. The grass layer includes the taller decreasers, STIPAs come in more, and forbs are less. Other species in this class are Artemisia, needle-and-thread, grama grasses.

Shrubs can be present at 20% cover, 0-0.5 meters. Grasses are still the dominant species, with patches of shrubs

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increasing in abundance under longer term fire intervals.

We would only expect to see approx 5% of BOGR2 in this late stage. PSSP6 could be another indicator or dominant. KOMA not very prevalent. SCSC could be another indicator. More bluebunch on westside of mapzone. Little bluestem will be coming in more east of Havre.

Club moss might be present on the Glaciated Plains at 0-5% cover, but not on shallow clay sites or dense clay sites, sands, saline upland, saline lowland, subirrigated or wet meadow.

Grazing is less frequent than in A due to palatability. There are more shrub-dependent wildlife species browsing. Grazing is modeled at 10% of this class each year.

Drought can occur along with a small amount of fire and can cause a transition back to A, every 100yrs - or 1% of this class each year.

Drought alone was modeled at every 30yrs, causing no transition. A reviewer felt that drought occurred more often, every five years, but because most wanted to model it at 30yrs, it was left as such.

There is a lower fire frequency than in A. Replacement fire is modeled at every 15yrs.

Insect/disease occurs very infrequently with a probability of 0.0001, returning the class to its early successional state, class A. It has been suggested that grasshoppers and Mormon crickets might have a larger impact historically than the probability assigned here. However, unsure of impact and frequency.

Class D **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Class E **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Disturbances

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Fire Regime Group:** II

Historical Fire Size (acres)

Avg
Min
Max

Sources of Fire Regime Data

☐ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	15	2	40	0.06667	100
Mixed					
Surface					
All Fires	15			0.06669	

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)	drought+native bison grazing + small fire portion
☑ Wind/Weather/Stress	☐ Competition	☑ Other (optional 2)	prairie dog grazing

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**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.

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011450 Rocky Mountain Subalpine-Montane Mesic Meadow

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

General Information

Contributors (also see the Comments field) **Date** 11/6/2006

Modeler 1	Steve Barrett	sbarrett@mtdig.net	**Reviewer**	Steve Barrett	sbarrett@mtdig.net
Modeler 2	Cheri Howe	chowell02@fs.fed.us	**Reviewer**	Mary Manning	mmanning@fs.fed.us
Modeler 3	Julia Richardson	jhrichardson@fs.fed.us	**Reviewer**		

Vegetation Type
Upland Grassland/Herbaceous

Map Zone
20

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

Dominant Species*
ERIGE2 LUPIN
MERTE SOLID
PENST DECA18
CAMPA KOELE

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Found in the Rocky Mountains. In MZ20, this BpS is very limited in extent.

Biophysical Site Description
This type is a lower montane to subalpine type found above 2000m in elevation in the southern part of its range and above 600m in the northern part. Finely textured soils. Snow deposition and wind swept dry conditions limit tree establishment. On gentle to moderate gradient slopes. Soils seasonally moist in spring, drying out later in the growing season.

Vegetation Description
Vegetation is typically forb-rich, with forbs contributing more to overall herbaceous cover than graminoids. Important taxa include Agastache urticifolia, Chamerion angustifolium, Erigeron spp, Senecio spp, Helianthella spp, Mertensia spp, Penstemon spp, Campanula spp., Hackelia spp, Lupinus spp, Solidago spp, Ligusticum spp, Osmorhiza spp, Thalictrum spp, Valeriana spp, Veratrum spp, Delphinium spp, Aconitum spp, Balsamorhiza sagitatta and Wyethia spp. Burrowing mammals can increase for density.

Disturbance Description
Fires are primarily replacement and occur about every 40yrs (MZ10/19 modelers). Mixed severity fire (mean FRI of 75yrs) occurs in late development meadows and removes shrubs. (During review of MZ20, the occurrence of mixed severity fire in this system was questioned and therefore removed.) The ignition source is generally not in this type and spreads from adjacent shrub or tree dominated sites, such as lodgepole pine, mountain big sagebrush, ponderosa pine and aspen.

For MZs 10 and19, the fire frequency of 40yrs was estimated based on adjacent aspen, herbaceous and sagebrush communities. Also, because fire was assumed to occur in the fall and spring when the summer's

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green and wet biomass would be dead and cured, replacement fire has little effect on annual tall forbs themselves. Fires would affect encroaching shrubs.

During review for MZ20, this frequent fire return interval was questioned. Multiple other models (in the Great Basin and MZs 10 and 19) used a frequent FRI, as this type occurs in mosaics with woodlands and dense shrublands. It is doubtful, however, that mesic, forbaceous meadows above 3000m would ever have MFIs of less than 150-300yrs, in contrast to the Great Basin's model and FRI of 40yrs. If this type is primarily a high elevation, subalpine wet-forb community (ie, MZs 10 and 19 description says >3000m--which would be too high for the Northern Rockies, where it would be more like 2000-3000m), a 150-200yr MFI would likely apply. However, if this type is a lower montane-to-subalpine type (as per NatureServe (NS) description), a lower MFI could apply. MZ20 decided to go with a model with a 75-100yrs MFI (using 85yrs MFI as a midpoint), since NS's description called for more of that type of an MFI as opposed to the high-high elevation, which would not occur in the Northern and Central Rockies (Barrett, pers comm). Also - this 85yr MFI is similar to the MFI chosen for MZ20's 1140 as well, since the range could vary greatly and due to both of the systems' ambiguous descriptions.

Moreover, the general absence of frequently fire-scarred trees adjacent to high elevation mesic meadows suggests that the BpS likely has fire frequencies similar to the adjacent treed landscape (Barrett, pers comm). The MFI depends on the size of these meadows and fuel load of adjacent vegetation presumably conifer forest. If the meadow is larger, it might act as a fire break and not completely burn. It depends on the moisture in the meadow and fuel load. Determining one value for an MFI will be difficult - will depend on size of meadow, landscape position and associated valley type, and surrounding veg type and patterns of fuel build-up, moisture, density and type of meadow - wet, dry, forb dominated, sedge dominated, moss dominated, etc. (Manning, pers comm).

Adjacency or Identification Concerns

This BpS could be confused with low forb/alpine shrub communities. Often adjacent to aspen/tall forb communities, mountain or big sagebrush/tall forb communities and upper montane/subalpine spruce-fir communities. In degraded sites this community may convert to silver sagebrush/tall forb.

With heavy grazing these sites can convert to undesirable forbs and grasses such as Circium spp (thistle), Galium spp (bedstraw), Rudbeckia occidentalis (coneflower), Helenium hoopesii (Orange sneezeweed), Polygonum spp (knotweed), Rumex spp (sorrel or dock), Taraxacum officinale (dandelion), Wyethia amplexicaulis (mulesears), Madia glomerata (mountain tarweed), Descurainia spp (tansymustard), Nemophila brevifolia (basin blue eyes), Poa pratensis (Kentucky bluegrass), Agrostis exarata (bentgrass), Dactylis glomerata (orchardgrass), Bromus inermis (smooth brome), Bromus tectorum (cheatgrass), Poa bulbosa (bulbous bluegrass) and Vulpia octoflora (six-week fescue). Roads and trails can impact these sites.

Native Uncharacteristic Conditions

Scale Description

Range in size from less than ten acres to 300ac.

Issues/Problems

There is not much information about this type.

Comments

This model for MZ20 was adapted from the model for the same BpS from MZ19 created by Cheri Howe and Julia Richardson and reviewed by Nathan Williamson, Vic Ecklund and Chuck Kostecka. Quantitative and descriptive changes were made to better fit the concept of this BpS, esp for NCR; original modelers' names

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were still retained, as they created most of the model (at request of MZ20 modelers). For MZ20, descriptive additions and changes were made to better reflect MZ20 sites.

For MZs 10 and 19, this is nearly identical to the model for the same BpS in MZs 16, 23, 24 and 28. The model was reviewed for MZs 10 and 19 by Mary Manning (mmanning@fs.fed.us). Minor edits were made to the description for MZs 10 and 19.

Vegetation Classes

Class A 5%

Early Development 1 Open

Upper Layer Lifeform

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

Fuel Model 1

Indicator Species* and Canopy Position

ERIGE2	Upper
LUPIN	Upper
DECA18	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	100%
Height	Herb 0m	Herb 0.5m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

Vegetation is typically forb-rich, with forbs contributing more to overall herbaceous cover than graminoids. Succession to class B after three years. Replacement fire (mean FRI of 85yrs) presumably occurred during the fall and spring, therefore removing completely dead biomass; in these early development meadows, fire would remove dead annual forbs. The original model for MZs 10 and 19, used a relative age of zero, implying no setback; however, MZ20 used the standard relative age of -2.

Class B 20%

Mid Development 1 Open

Upper Layer Lifeform

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

Fuel Model 1

Indicator Species* and Canopy Position

ERIGE2	Upper
LUPIN	Upper
DECA	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	100%
Height	Herb 0.6m	Herb 1.0m
Tree Size Class	None	

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

Shrubs may be present, but will be less than five percent cover.

Description

Vegetation is typically forb-rich, with forbs contributing more to overall herbaceous cover than graminoids. Some increase in shrub component, shrubs young and less than five percent cover. Succession to C after 20yrs. Replacement fire removes shrubs (mean FRI of 85yrs).

Class C 75%

Late Development 1 Open

Upper Layer Lifeform

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

Fuel Model 1

Indicator Species* and Canopy Position

ASTER	Middle
LUPIN	Middle
ROWO	Middle
RIBES	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	20%
Height	Shrub 0m	Shrub >3.1m
Tree Size Class	Seedling <4.5ft	

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

Forbs dominate. Trees (Populus tremuloides) or shrubs (Artemisia cana, Artemisia tridentata,

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Rosa woodsii, Ribes spp and Amelanchier spp.) may be the upper layer lifeform, with low canopy cover (<10%).

Description

Vegetation is typically forb-rich, with forbs contributing more to overall herbaceous cover than graminoids. Five to 10% of cover in late seral may be woody species from adjacent plant communities such as Populus tremuloides, Artemisia cana, Artemisia tridentata, Rosa woodsii, Ribes spp and Amelanchier spp. Replacement fire (mean FRI of 85yrs) sets site back to class A.

This was originally modeled in MZs 10 and 19 with a shrub cover of under 10% of shrubs. However, due to guidance from MFSL, the cover could not be <10%. Therefore, shrub cover was increased to 20%.

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 50
Min 1
Max 250

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	85	30	200	0.01176	100
Mixed					
Surface					
All Fires	85			0.01178	

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.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Additional Disturbances Modeled

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

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011480 Western Great Plains Sand Prairie

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

General Information

Contributors (also see the Comments field) **Date** 4/6/2006

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Vegetation Type
Upland Grassland/Herbaceous

Map Zone
20

Model Zone

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

Dominant Species*
CALO SPCR
SCSC
BOGR2
HECO26

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
Predominantly the eastern portion of MZ20. Also found in scattered pockets elswhere throught the zone. It probably occurs on the Charles Russel National Wildlife Refuge. In 331Kf, this might occur.

Biophysical Site Description
This BpS would be found in NRCS's sand type or the Sandy Ecological site description. Occurs around sandstone outcrops.

Vegetation Description
Dominant vegetation includes Prairie Sandreed (Calamovilfa longifolia), Little Bluestem (Schizachyrium scoparium), Blue Grama (Bouteloua gracilis), Needle and Thread (Stipa comata) and Sand Dropseed (Sporobolus cryptandrus). Shrubs seen may include horizontal juniper (Juniperus horizontalis), silver sage (Artmeisia cana) and skunkbrush (Rhus trilobata). Further east (not in MZ20), BOHI2 and ANHA might occur.

Disturbance Description
Fire, grazing and drought were the primary disturbances. Disturbances were cyclic with the earliest and latest seral stages fluctuating widely in accordance with changes in climate.

The principal large grazer of the system was most likely bison which, when occurring in large numbers, would have locally disturbed large areas due both to grazing impact and physical disturbances such as trampling and wallowing. Grazing impacts are more pronounced near water and removed from steep, rough terrain. Overall the whole system would have been frequently impacted by large ungulate grazers.

Prairie dogs might have been a minor component of the system. Where they occurred, prairie dogs grazed

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**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 close to the ground which provided a local firebreak. It is questionable, however, as to whether prairie dogs prefer sandy soil and actually occurred here. It is thought that prairie dogs would not occur on these sandy sites and rather they usually occur on fixe textured soils.

Fire was a frequent and widespread occurence. The most extensive fires are likely to have occurred in years with wet springs followed by hot, dry summers when grazing pressure was low. Wet springs would have resulted in more productive and more continuous plant cover (ie, fuel) that would have supported and expanded fires ignited under dry conditions occurring later in the season. In addition, litter accumulation over several fire-free years would also have supported widespread fire, in any conditions. The litter component, a determining factor in fire size and frequency, is correlated with seral stage. Three to five fire-free years produce enough litter to carry another fire. Post-fire shifts in species composition depend on the timing and condition of fire. It is also speculated that native burning might have been an influence in this BpS.

Extended periods of severe drought is likely to have affected both species composition and the stability of the sandy soil, particularly when compounded by wind and heavy grazing. Droughts could affect the entire region.

Adjacency or Identification Concerns

Northwestern Plains Mixed Grass Prairie systems are often found nearby, especially in the western portion of the zone.

The disturbance regime has been drastically changed since European settlement; agriculture replaced bison and fires have been effectively suppressed.

Native Uncharacteristic Conditions

Scale Description

This is generally a patch that occurs within the larger northwestern plains mixed grass. Size probably varies widely, but is generally going to be 10s of thousands of acres in MZ29 at the large side versus hundreds of acres or less in MZ20.

In terms of disturbance impact, in MZ20, entire patches are going to be impacted, whereas it will vary to an unknown level in MZ29.

Issues/Problems

Very little data are available from presettlement times.

Comments

This model for MZ20 was adapted from the Rapid Assessment model R4NESP Nebraska Sandhills Prairie created by Tom Bragg (tbragg@mail.unomaha.edu), Mary Lata (mlata@fs.fed.us) and Dave Shadis (dshadis@fs.fed.us) and reviewed by John Ortmann (jortmann@tnc.org). Major descriptive and quantitative changes were made so that the model more appropriately represented MT, instead of NE.

Vegetation Classes

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Class A 20 %

Early Development 1 Open

Upper Layer Lifeform

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

Fuel Model

Indicator Species* and Canopy Position

SPCR	Upper
BOGR2	Lower
SCSC	Upper
CALO	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	40 %
Height	Herb 0m	Herb 0.5m
Tree Size Class	no data	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class A represents immediate to three year post disturbance conditions. Vegetation consists of resprouting and seedling grass and forbs. Total bare soil is greater than before the disturbance particularly on less productive sites. The vigor of new growth and the specific species affected depend on the season of the disturbance and on pre- and post-disturbance environmental conditions (eg, available soil moisture). Litter is low initially but increases until, by year three, there is enough to support fire under average burning conditions. Fire was therefore modeled as occuring somewhat less frequently than in class B. In uplands, where soil-type is dominated by coarse-grained sands with low water-holding capacity, post-disturbance primary production initially decreases thus fire may only carry under ideal conditions. Under these conditions, grazing is likely to be light. In lowlands, with finer-textured soils, primary production is determined largely by moisture availability.

It was originally suggested that there be a prairie-dog influenced stage at approximately two percent of the landscape. However, there was some disagreement as to whether this class should exist or not for this system, as it is thought that these sandy sites might have been unlikely to have prairie dog towns. It was only distinguished from A by different species (Buchloe dactyloides - only in the extreme southeast portion of the stage and Bouteloua gracilis and Agropyron dasystachyum). Canopy cover was 0-20%. This (very unlikely) prairie dog influenced class was therefore merged into the early successional stage, class A. It is doubtful that prariie dogs would colonize very sandy sites; most prairie dog sites have fairly fine-textured soils.

Repeated grazing of these areas will prevent succession to Class B. Grazing occurs with a probability of 0.05. Prairie dog grazing was modeled as optional 1, with a very unlikely probability of 0.0007.

Replacement fires occur every 40yrs (due to less litter until the last years of this class, they were modeled as occurring less frequently than in class B. (20yr vs 40yr FRI does not change percentages in each class.)

Class B 80 %

Late Development 1 Closed

Upper Layer Lifeform

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

Fuel Model 1

Indicator Species* and Canopy Position

CALO	Upper
SCSC	Upper
BOGR2	Lower
ARCA13	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	60 %
Height	Herb 0m	Herb 1.0m
Tree Size Class	no data	

☐ Upper layer lifeform differs from dominant lifeform.

Description

This system was originally modeled as a four-box model with a mid and late stage; however, it was changed to a three-box model, combining the mid and late stages, since species and structural info was very similar, as were disturbances. It was then combined into a two-box model because of the lack of a prairie dog stage.

This mid-to-late seral stage would persist three years after a fire. The maximum cover height for grasses would

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**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.

be approximately 60%, even though in other mapzones, cover might be much higher.

Other species indicators could be JUHO2 and SPCR - in the later part of this stage. Various sprouting shrubs may be established. The shrubs are as tall or taller than the grasses, but they would not be dominant; shrubs might occupy approximately 10% of the area. Some of the shrubs include Juniper horizontalis and skunkbush sumac (Rhus trilobata). Other woody species such as chokecherry (Prunus virginiana) and snowberry (Symphoricarpos occidentalis) may also be established.

This stage includes moderate grazing by native ungulates and insects.

Litter accumulates providing continuous fuel for fires thereby increasing the probability of larger fires. However, for the model, fires were attributed similarly between classes A and B.

Prairie dogs might impact this class with a very unlikely probability of 0.0007, bringing this class back to class A.

Other native grazing occurs with a probability of 0.01, bringing the class back to an early seral state, or with a probability of 0.15, maintaining this stage.

Replacement fires occur every 20yrs.

Class C **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Class D **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Class E **0 %**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Disturbances

Fire Regime Group:** II

Historical Fire Size (acres)

Avg
Min
Max

Sources of Fire Regime Data

☑ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals	*Avg FI*	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	20	2	100	0.05	100
Mixed					
Surface					
All Fires	20			0.05002	

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
☐ Wind/Weather/Stress
☑ Native Grazing
☐ Competition
☑ Other (optional 1) Prairie Dogs
☐ Other (optional 2)

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011530 Inter-Mountain Basins Greasewood Flat

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

General Information

Contributors (also see the Comments field) **Date** 5/5/2006

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Vegetation Type
Wetlands/Riparian

Map Zone
20

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

Dominant Species*
SARCO PUCCI
DISTI
SPAI
PASM

General Model Sources
☐ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Occurs throughout much of the western US in intermountain basins and extends onto the western Great Plains. Occurs throughout zone in all subsections at lower elevations. In MZ20, this BpS is thought to be limited to very limited in extent.

Biophysical Site Description
Typically occurs near drainages, on stream terraces and flats or may form rings around more sparsely vegetated playas. Sites typically have saline soils, shallow water table and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations.

Vegetation Description
This system sometimes occurs as a mosaic of multiple communities, with open to moderately-dense shrublands dominated or co-dominated by Sarcobatus vermiculatus (greasewood). Atriplex confertifolia (shadscale) or Krascheninnikovia lanata (winterfat) may be present or co-dominant. Occurrences are often surrounded by mixed salt desert scrub. Herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of Sporobolus airoides (alkali sacaton), Distichilis spicata (saltgrass) or Eleocharis palustrus (spikerush). In MZ22 very little Atriplex confertifolia (shadscale) but rather Atiplex gardneri. Artemsesia tridentata tridentata is common in southwest part of MZ22, more in riparian systems, Artemesia wyomingensis occurs more on the playa types.

Disturbance Description
Historically, fire was extremely infrequent. There is conflicting evidence about mean FRI in this system. Anderson (2004) claims a FRI <100yrs, whereas expert opinion considers fire rare to absent in greasewood. As a compromise, a mean FRI of 200yrs was chosen here.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Greasewood is a vigorous resprouter following low to moderate severity fires, although severe fires may result in some mortality. Some re-seeding may occur from nearby remnant plants.

Greasewood may be killed by standing water that lasts greater than 40 days.

Adjacency or Identification Concerns

Greasewood communities are susceptible to invasion by non-native annual grasses (cheatgrass).

Native Uncharacteristic Conditions

Scale Description

One to hundreds of acres.

Issues/Problems

Comments

This model for MZ20 was adopted as-is from the draft model from the same BpS from MZ22. No changes were made yet.

This model for MZ22 was adapted from the model from the same BpS from MZ23 created by Jolie Pollet, Annie Brown and Stan Kitchen. Quantitative and descriptive changes were made, and it was changed to a two-box model.

The model for MZ23 is identical to the model for the same BpS in MZ16 (Utah High Plateaus) and did not receive any peer review.

Vegetation Classes

Class A 5%

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 2

Indicator Species* and Canopy Position

DISTI	Lower
SPAI	Lower
	Upper
	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	20 %
Height	Shrub 0m	Shrub 0.5m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Some grasses, with greasewood sprouts present. Some representation of other sprouting species may be present such as rabbitbrush (Ericameria nauseosus). Grass species vary geographically, but include the following: inland saltgrass, bottlebrush squirreltail and alkali sacaton. Succession to class B after two years.

Class B 95%

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 2

Indicator Species* and Canopy Position

SARCO	Upper
DISTI	Lower
SPAI	Lower
	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	50 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

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**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.

Greasewood shrubs maturing or have reached maturity, and will increase canopy closure. Perennial grasses will still be in the understory. Vegetation will revert to class A with replacement fire (mean FRI of 200yrs). Flooding (mean return interval of 75yrs) causes a transition to class A.

Shrubs probably only reach heights of 1.5 meters.

Class C **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐Herbaceous
☐Shrub
☐Tree

Fuel Model

Description

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.

Class D **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐Herbaceous
☐Shrub
☐Tree

Fuel Model

Description

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.

Class E **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐Herbaceous
☐Shrub
☐Tree

Fuel Model

Description

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.

Disturbances

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Fire Regime Group:** V

Historical Fire Size (acres)

Avg 50
Min 10
Max 200

Sources of Fire Regime Data

- ☐ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	210	100	800	0.00476	100
Mixed					
Surface					
All Fires	210			0.00478	

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

References

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011590 Rocky Mountain Montane Riparian Systems

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

General Information

Contributors (also see the Comments field) **Date** 6/13/2006

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Modeler 2	Steve Barrett	sbarrett@mtdig.net	**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type
Wetlands/Riparian

Map Zone
20

Model Zone

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

Dominant Species*
POPUL CRRI
SALIX EQAR
COSE16
CAREX

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
This system is found throughout the Rocky Mountains and Colorado Plateau regions. In MZ21, it occurs throughout the zone and is more common than BpS 1154 (black cottonwood) on rivers. It is associated with the isolated mountain ranges in MZ20.

Biophysical Site Description
This system occurs within a broad elevation range from approximately 900m (3000ft) to 2800m (9200ft) within the flood zone of rivers, on islands, sand or cobble bars, and streambanks. The upper limit for MZ20 is probably approximately 2050m (6725ft). Typically this system exists in large, wide occurrences on mid-channel islands in larger rivers or narrow linear bands on small, rocky canyon tributaries and well drained benches and hillslopes below seeps/springs. May also include overflow channels, backwater sloughs, cut-off meanders, floodplain swales and irrigation ditches. Surface water is generally high for variable periods. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition.

Vegetation Description
This ecological system occurs as a mosaic of multiple communities that are tree dominated with a diverse shrub understory. Deciduous woody trees dominate, including: Populus deltoides (not in MT montane systems - don't occur much over 4000ft in MT), Populus angustifolia (east of the continental divide), and the tree willow, Salix amyglioides. Fraxinus pennsylvannicus is found at lower elevations. Fraxinus pennsylvanicus is not in MT montane systems - doesn't occur much over 4000ft in MT. It does become a dominant in MZ30 riparian areas where it comes in after P. deltoides, and though it grows much more slowly, it persists after P. deltoides because it can recruit into shaded, relatively undisturbed sites.

Dominant shrubs include Acer negundo, Alnus incana, Cornus sericea, Crataegus rivularis, Prunus virginiana, Sheperdia argentea and numerous tall willow species: Salix lutea, S. geyeriana, S. boothii, S.

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drummondiana, S. lasiandra, S. bebbiana and S. exigua. Acer glabrum exists in MZ20, but it isn't a dominant shrub - Acer negundo is more common. Alnus incana and Betula occidentalis are minor components of MZ20.

Generally the adjacent upland vegetation surrounding this riparian system includes shrublands, grasslands and forests.

Forbs and graminoids include Carex spp, especially Carex utriculata and Carex aaquatilis, which occur in nearly homogeneous stands, and numerous mesic forbs (eg, Geum macrophyllum, Mertensia ciliatus, Equisetum arvense and Senecio hydrophilus).

Disturbance Description

This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. Flood events of increasing magnitude will cause maintenance to stand replacing disturbances.

Beaver (Castor canadensis) crop younger cottonwoods (Populus spp) and willows (Salix spp), and frequently influence the hydrologic regime through construction of dams (ponding water and slow release). Beavers show considerable movement along rivers as available trees are felled.

Fire is mostly occurring as a result of spread from surrounding uplands. Many of these species, especially shrubs, respond favorably to fire. They are vigorous sprouters and are also shade intolerant; the absence of fire and shading by conifers will cause a decrease in these communities. Most fires would ignite and move through upland fuel until they reached a riparian zone; then either go out because of high fuel moisture, continue spreading into dry riparian fuel or leap across damp streams and continue up the hill on the other side. Streams could be a barrier to low/moderate intensity fires, but would hardly slow down a high intensity crown fire (Michael Harrington, pers comm, observations on the Bitterroot 2000). It is thought that the lower elevation forests (ponderosa pine dominated) were capable of burning during a large portion of the summer and fall because of the rapid drying of the types of fine fuel that is present, whereas intersecting riparian area fuel had a longer seasonal exposure to soil moisture and high humidity. So, this indicates a period, especially in early summer where it seems upland were burnable and riparian zones were less so. These two zones generally become more similar as summer deepens (Harrington, pers comm).

Olson (2000) found that riparian Weibull median probability fire return intervals for riparian forests (in OR, however), ranged from 10-40yrs. Forest type and slope aspect played a larger role than proximity to a stream when it came to differentiating fire regimes in the study area. Stream channels also did not act as fire barriers during the more extensive fire years (Olson 2000).

The fire disturbances, flooding events and beaver herbivory is modeled at much longer intervals in MZ21 than in MZs 10 and 19. The fire return intervals in MZ21 (175yrs FRI overall) for this BpS are approximately the same as those for 211154. MZ12 used a 300yrs+ FRI. For MZ20, FRIs (65yrs FRI overall) are modeled similarly to those in MZs 10 and 19 (50yrs FRI overall). It is thought that the associated regime for MZ20 would be usually influenced by the surrounding dominant montane forest, which is largely FRG I or III. For this riparian BpS in MZ20, it is expected that FRG would be II or III.

Adjacency or Identification Concerns

This BpS encompasses the mid and lower-elevation riparian systems within the northern Rocky Mountains. Higher elevation riparian systems are covered in BpS 1160.

Absence of recurrent floods and fire as a structuring agent, coupled with shade tolerant conifer establishment

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can lead to loss of shade intolerant deciduous woody species. In addition, grazing and trampling by domestic and wild ungulates can shift the composition toward weedy and/or nonriparian species. Associated bank damage, which results in headcutting and incision, can result when bank stabilizing vegetation is removed and/or damaged by ungulate activity. In addition, loss of beavers can, coupled with heavy ungulate use, shift dominance in these systems to herbaceous species.

Exotic trees of Russian olive (Elaeagnus angustifolia), especially in lower elevation, wide valley bottom systems, are common in some stands. Herbaceous noxious weeds, including leafy spurge, tansy and spotted knapweed readily invade and persist in these systems today.

Grazing disturbance could be a disturbance in certain locales. Tamarisk is becoming a concern. Trapping of beaver affects beaver presence, thus storage of ground water and recharge of the local aquifer. Perennial pepperweed may be an issue as well.

The best guide for mappers to distinguish between floodplain systems vs riparian systems is the geographic range/ecoregions. The Great Plains Floodplain systems are in the Northwestern Glaciated Plains and the Northern Great Plains; the Rocky Mountain Montane Riparian systems are in the lower elevations (ie, not alpine) of the Northern and Middle Rockies, some of which occur as isolated mountain ranges in the Great Plains. Broadly generalized, the Great Plains Floodplain systems typically have broader floodplains and more terrace development. Also - montane riparian systems of central Montana and probably the Black Hills too will have steeper gradients, narrower floodplains and be dominated by Populus angustifolia or P. alsamifera as opposed to P. deltoides for Great Plains floodplains. Rivers like the Powder, Tongue and probably Little Missouri start as montane rivers and become Great Plains rivers.

Native Uncharacteristic Conditions

Scale Description

These systems can exist as small to large linear features in the landscape. In larger, low elevation riverine systems, this system may exist as mid-large patches, as a function of valley bottom width and gradient.

Issues/Problems

Comments

This model for MZ20 was adapted from the same BpS in MZ21, created by John Simons (john_simons@blm.gov) and Bill Baker (bakerwl@uwyo.edu) and reviewed by Chris Baker (clbaker@fs.fed.us), Jim Ozenberger (Jozenberger@fs.fed.us), Andy Norman (anorman@fs.fed.us), Sarah Canham (scanham@fs.fed.us) and Brenda Fiddick (bfiddick@fs.fed.us). Quantitative and descriptive changes were made, and the model's FRI for MZ20 more closely resembles that for MZs 10 and 19.

The model for MZ21 is based on the LANDFIRE model for the same BpS 1159 for MZ10 created by Don Major (dmajor@tnc.org) and Mary Manning (mmanning@fs.fed.us) and reviewed by Carly Gibson (cgibson@fs.fed.us), Cathy Stewart (cstewart@fs.fed.us) and John DiBari (jndibari@yahoo.com). Many quantitative changes were made to the model for MZ21 so that fire and other disturbance intervals matched those in 211154 (Black Cottonwood). The disturbance model should be identical to that in 1154 (Black cottonwood).

Additional reviewer for MZ10 was Steve Barrett (sbarrett@mtdig.net). MZ10 model was adapted from a model for the same BpS in MZs 12 and 17. The VDDT model for this system for MZ10 was taken from BpS 1160 and modified to highlight the dominance of the hydrologic regime.

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Vegetation Classes

Class A 15%

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 3

Indicator Species* and Canopy Position

POPUL	Upper
SALIX	Upper
COSE16	Middle
CAREX	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Immediate post-disturbance responses are dependent on pre-burn vegetation composition. This class is dominated by sprouting shrubs that respond favorably to fire. Species composition is highly variable. Silt, gravel, cobble and woody debris may be common.

Generally, this class is expected to occur 1-5yrs post-disturbance. Replacement fire (100yrs), beavers (0.05 probability - ie, 20yrs; or 5% of class each year), will set this class back to the beginning. Flooding (0.05 probability) will maintain this class.

Class B 45%

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 3

Indicator Species* and Canopy Position

POPUL	Upper
SALIX	Mid-Upper
COSE16	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Shrub 3.1m	Shrub >3.1m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Highly dependent on the hydrologic regime. Vegetation composition includes tall shrubs and small trees (cottonwood, aspen and conifers). This class persists for approximately 20-25yrs.

Modeled disturbances include: 1) weather-related stress expressed as annual flooding events occuring every five years, which maintains vegetation in class B, and 2) periodic flooding events (weather-related stress) every 100yrs causing stand replacement, 3) replacement and mixed severity fire every 100yrs each, (mixed causing no transition) and 4) beaver (Castor canadensis) herbivory (Option1). Beaver herbivory occurs causing, respectively, a transition back to class A every 40yrs and maintenance in class B every 40yrs. Succession to class C after approximately 25yrs.

Class C 40%

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 3

Indicator Species* and Canopy Position

POPUL	Upper
PINUS	Upper
SALIX	Mid-Upper
JUSC2	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Tree 0m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

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This class represents the mature, large cottonwood, conifer, etc. woodlands. In MT, these closed late systems can also be dominated by Rocky Mountain juniper, or spruce at higher elevations, and green ash at lower elevations. Ponderosa pine is only one possible dominant. Red osier dogwood is an indicator in all of these, with a range of 10-60% cover depending on overstory species. Other dominant and indicator species are interior Douglas-fir in the upland areas, PICEA, FRAPEN and COSE16.

Generally, this class persists until a replacement disturbance (beavers, flooding and replacement fire) cause a transition to class A.

Some flooding events (weather-related stress) cause a transition to class A every 200yrs, whereas other flood events cause a transition to class B every 200yrs and some occur every five years but just maintain the class.

Replacement fire is caused by importation from surrounding systems. Replacement and mixed fire overall every 100yrs each (mixed causing no transition).

Beaver activity is very infrequent (0.001 probability) causing a thinning disturbance to class B, but some beaver activity is frequent (5-10yrs) but just maintains this class.

Ice scour occurs often (5-10yrs "option 2"), but rarely kills large patches of trees, and instead causes no transition to another class.

Class D **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Class E **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Disturbances

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Fire Regime Group:** III

Historical Fire Size (acres)

Avg 100
Min 1
Max 1000

Sources of Fire Regime Data

- ☐ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	100	75	275	0.01	53
Mixed	115			0.0087	46
Surface					
All Fires	53			0.01871	

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
- ☑ Wind/Weather/Stress
- ☐ Native Grazing
- ☐ Competition
- ☑ Other (optional 1) Beaver
- ☑ Other (optional 2) ice scour

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011600 Rocky Mountain Subalpine/Upper Montane Riparian Systems

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

General Information

Contributors (also see the Comments field) **Date** 6/13/2006

Modeler 1	Linda Vance	livance@mt.gov	**Reviewer**	Mary Manning	mmanning@fs.fed.us
Modeler 2	Steve Barrrett	sbarrett@mtdig.net	**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type
Wetlands/Riparian

Map Zone
20

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

Dominant Species*
SALIX ABLA
CAREX PIEN
PSEUD7 POPUL
PICO PICEA

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
Higher elevations in the zone down to valley riverbottoms. In MZ20, this BpS is very limited in extent.

Biophysical Site Description
This ecological system represents the combination of numerous riparian types occurring in the upper montane/sub-alpine zones. Found at 900-3000 m (3,000-10,000 feet), but range is probably more like 6-8,000 feet in mapzone 20. This ecological system typically exists as relatively small linear stringers, but can occupy relatively wide and flat valleys. This is a widely dispersed type generally adjacent to live water.

Although reviewers recommended that the descriptions be made less broad so as to adhere more to high elevation, it was decided that this type includes montane and subalpine elevations and therefore descriptions were kept broad.

These wetlands typically are in small upper-elevation watersheds that periodically experience high rainfall in short periods from late season snowmelt and convective thunderstorms.

Vegetation Description
These systems are highly variable and generally consist of one or more of the following five basic vegetation forms: 1) cottonwoods; 2) willows and other shrubs; 3) sedges and other herbaceous vegetation; 4) aspen; and 5) conifers (primarily spruce and sub-alpine fir).

This BpS encompasses a broad array of riparian species. It is composed of seasonally flooded forests, woodlands and shrublands found at montane to subalpine elevations.

Shrubs include bog birch, and willows (e.g., Salix planifolia, S. wolfii, S. drummondii, S. geyeriana, S.

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bebbiana) among others.

Graminoids include tufted hairgrass, bluejoint reedgrass, beaked sedge (Carex utriculata), and water sedge (Carex aquatilis), among others.

Other salix species for mapzone 20 may include Salix candida, S. lutea, S. planifolia, S. serissima, S. barclayi, S. exigua, S. lasiandra, S. psudomonticola, S. commutata, S. tweedyi.

At lower elevations in zone 20, some of this riparian type (e.g. the S. exigua community type) typically includes cottonwood species. At higher elevations, S. geyeriana communities often includes aspen. At the highest elevations, S. planifolia sometimes has a spruce-fir-lodgepole component. In mapzone 20, high elevation meadows have the spruce-fir component interspersed in the wetlands along with the addition of lodgepole pine. These occupy low-gradient alluvial settings.

Disturbance Description

Flooding events and availability of water during drier periods are the major influences to this system, as a function of slope. Frequent flood events maintain vegetation but do not scour it, whereas larger, infrequent flood events scour and deposit sediments, resetting succession to early development, depending on vegetation.

Reviewers felt that this BpS 1160 is more consistently wet with deep root systems, deep fens, springs, and small streams; flooding events aren't the major influence. Short growing season, temperature, radiation, avalanches, snow events, ice and scouring, herbivory and possibly long-interval fire regimes are major disturbances, but more data are still needed (Ozenberger, personal communication).

These wetlands are in small upper-elevation watersheds that periodically experience high rainfall in short periods from convective thunderstorms, leading to rapid runoff and mobilization of the fine alluvium in willow-dominated areas and even some of the rocks in conifer-dominated riparian on steeper gradients. Floods in willow-dominated alluvium may not show up as rushing streams scouring banks, but more as a rising bathtub type of flood. Alluvium does get moved and willows get topkilled by inundation or by deposition or removal of alluvium (MZ21 anonymous contributor, personal correspondence). In mapzone 20, at least, these watersheds are also common at lower elevations too.

Sites are probably fairly lush, so fires may skip over them. This would be a patchy replacement fire, topkilling all the vegetation. Most of the species are fire-adapted and would respond favorably (Dwire et al. 2004).

Fire intervals for mapzone 21 were modeled as 3x longer than those in mapzones 10, 19.

Beaver (Castor canadensis) crop cottonwoods (Populus spp.) and willows (Salix spp.), and frequently influence the hydrologic regime through construction of dams (ponding water and slow release). Beavers show movement along rivers as available trees are felled.

Adjacency or Identification Concerns

This BpS includes narrow to moderately wide meadows, shrublands, and woodlands of conifers and aspen. It is adjacent to conifer / deciduous forest.

Over-grazing and irrigation use have had major impacts on some of these systems. Exotics in this setting are primarily Kentucky bluegrass, smooth brome, quackgrass, redtop, timothy, orchardgrass, and dandelion.

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Domestic sheep may be an issue in the Wyoming and Wind River Ranges. Global warming and acid rain may affect vegetation.

Native Uncharacteristic Conditions

Scale Description

These systems are small linear or relatively wide features in the landscape.

Per NatureServe, stands are variable, occurring as narrow bands of trees and/or shrubs lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels to larger floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons.

Issues/Problems

Comments

This model for MZ20 was adapted from the same BpS in MZ21 created by Tim Klukas (tim_klukas@nps.gov), John Simons (john_simons@blm.gov) and an anonymous contributor and reviewed by Jim Ozenberger (jozenberger@fs.fed.us), Andy Norman (anorman@fs.fed.us), Sarah Canham (scanham@fs.fed.us), and Brenda Fiddick (bfiddick@fs.fed.us). Descriptive and quantitative changes were made to better reflect MZ20 and to have the FRI resemble other mapzones' and other adjacent systems more closely. Descriptive and other quantitative changes were made upon further review, to more closely match the models from MZs 10,19,12,17.

The model for MZ21 was adapted from the LANDFIRE models for the same BpS 1160 from MZs 10, 19, 12, 17 and 16; models from MZs 10 and 19 created by Don Major (dmajor@tnc.org) and Mary Manning (mmanning@fs.fed.us) and reviewed by Carly Gibson (cgibson@fs.fed.us), Cathy Stewart (cstewart@fs.fed.us), John DiBari (jndibari@yahoo.com),and Steve Barrett (sbarrett@mtdig.net). For MZ21, descriptions were modified, and fire intervals were changed/increased (less fire).

Vegetation Classes

Class A **55 %**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 3

Indicator Species* and Canopy Position

SALIX	Upper
CAREX	Upper
PSEUD7	Middle
POPUL	Middle

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0 %	50 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Immediate post-fire responses in this ecological system are dependent on pre-burn vegetation form. Post-burn condition sensitive to scouring and blow-out from floods. Generally, this class is expected to occur 1-3yrs post-disturbance. This class is shrub or grass dominated. Composition varies both within/among reaches. This class succeeds to B in 20yrs. Succession is highly variable due to high moisture levels and high species variability.

This class could contain seedlings of Douglas-fir, lodgepole pine, cottonwood, aspen, spruce, subalpine fir.

Flooding disturbances (modeled as weather-related stress) include events that do not scour every two years and

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events that reset the vegetation to age 0 every 100yrs (option 2).

Beaver (Option 1) reset succession every 10yrs by moving along the river with tree depletion.

Replacement and mixed fire were modeled with an overall FRI of 150yrs, split 50/50.

Native grazing occurs very infrequently (probability .001).

Class B **45%**

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 3

Indicator Species* and Canopy Position

SALIX	Middle
CAREX	Middle
PSEUD7	Upper
POPUL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	100 %
Height	Tree 0m	Tree 50m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Highly dependent on the hydrologic regime. For example, could include any combination of the 5 vegetation forms described above in "Vegetation Description". Composition of adjacent uplands is the determining factor for future fire events.

This class contains grasses, shrubs, and maturing trees of Douglas-fir, lodgepole pine, cottonwood, aspen, spruce, subalpine fir.

Replacement and mixed fire were modeled with an overall FRI of 150yrs, split 50/50.

100-year flood events (option 2) reset vegetation to early class. Every 33yrs, beavers (option 1), and every 10yrs, non-scouring flooding occur but have no effect on succession classes.

Class C **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 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.

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**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.

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:** **III**

Historical Fire Size (acres)

Avg 10
Min 1
Max 100

Sources of Fire Regime Data

☐ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	300	100	500	0.00333	50
Mixed	300			0.00333	50
Surface					
All Fires	150			0.00668	

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
☑ Wind/Weather/Stress
☑ Native Grazing
☐ Competition
☑ Other (optional 1) Beaver
☑ Other (optional 2) 100-year flood events

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011610 Northern Rocky Mountain Conifer Swamp

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

General Information

Contributors (also see the Comments field) **Date** 11/18/2005

Modeler 1	Katie Phillips	cgphillips@fs.fed.us	**Reviewer**	Steve Barrett	sbarrett@mtdig.net
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Modeler 3	Larry Kaiser	larry_kaiser@blm.gov	**Reviewer**		

Vegetation Type
Wetlands/Riparian

Map Zone
20

Model Zone

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

Dominant Species*
PIEN
THPL

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Northern Rocky Mountains from northwestern WY north into the Canadian Rockies and west into eastern OR and WA. Most common where the inland Pacific maritime influence is strongest. The biggest expanse of late-successional status currently is from Upper Priest Lake, ID to the Canadian border.

Biophysical Site Description
Poorly drained soils that are saturated a significant portion of the growing season may have seasonal flooding in the spring. Soils conditions may include exposed rock and gravel at the surface or, more rarely, organic matter. Stands generally occupy sites on benches, toeslopes or valley bottoms along mountain streams. May occupy upland sites (especially on northerly aspects) where high water table allows saturation part of the growing season.

Vegetation Description
Composition will vary geographically, but is generally dominated by large, old Picea engelmannii. Thuja plicata may be present on warm-wet lowland sites as well. Large downed logs are often common (50 tons/acre possible). Large old cedars tend to have heartrot.

Understory associates will vary widely geographically, but include Oplopanax horridum (devil's club), Athyrium filix-femina, Dryopteris spp., Lysichiton americanus, Gymnocarpium dryopteris, Equisetum arvense, Senecio triangularis, Mitella breweri (colder and wetter end of the range), Mitella pentandra, Streptopus amplexifolius, and Calamagrostis canadensis (colder and wetter end of the range).

Disturbance Description
Fire regime group V with rare stand replacement fires (>200 yrs+). Fire frequency is highly dependant on adjacent vegetation and relative patch size compared to the surrounding matrix. In the subalpine zone, these systems act as fuel breaks. However, frequency of fire is increased where drainage is oriented with

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**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.

prevailing wind. Fuel loading in adjacent vegetation may sometimes be important. Small patch fire events (individual lightning strikes) may occur within patches, but do not meet the threshold of mixed severity fire.

Openings the overstory canopy often results in windthrow (Williams et al. 1995).

Spruce beetle outbreaks may occur and be linked to subsequent fire events.

Adjacency or Identification Concerns

The wetland types are generally distinguishable from other upland forests and woodlands by shallow water tables and mesic or hydric undergrowth vegetation.

Native Uncharacteristic Conditions

Scale Description

Linear features and smaller patches. 10s to 1000s of acres in size.

Issues/Problems

This is typically a small patch system and may be difficult to map.

This is a relatively stable ecosystem dominated by positive feedback mechanisms so were highly variable over space and time. Variability was dependent on patch size, native burning and adjacent vegetation.

Comments

For MZ20, this BpS was adopted as-is by MFSL from MZ19.

For MZ19 - Art Zack (azack@fs.fed.us) and Craig Glazier (cglazier@fs.fed.us) provided input to an earlier version of this model.

In general, modelers and reviewers had trouble with the NatureServe description of this type, as it combines two very different systems-- upland redcedar groves and lowland, seasonally flooded conifer (spruce) bogs. The upland redcedar type was split into a separate model for MZs 10 and 19 (10472), and this "conifer swamp" type was modeled differently than the NatureServe description. As a result of peer review, mixed severity fire was removed from the model.

Peer review resulted in general concern that this system is too small in concept compared to other BpS and should not be included in LANDFIRE.

This model was imported from MZ19 by Brendan Ward.

Vegetation Classes

Class A **10%**

Early Development 1 All Structures

Indicator Species* and Canopy Position

PIEN Mid-Upper

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0 %	100 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Description

Riparian sprouting species may be considered trees or shrubs. Nurse crops of white pine,

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lodgepole or cottonwood may comprise this class, in which case tree heights would be very tall (>30m).

Sprouting riparian shrubs and deciduous trees, such as black cottonwood, Douglas maple, willow and birch. Engelmann spruce and some other conifers may be regenerating.

The probability of fire is highest in this class and fires will often creep in from adjacent vegetation types.

Loss of large trees post-burn can alter the water table and reduce subsequent tree regeneration, causing this class to last many years.

Class B **20%**

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIEN Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	100%
Height	Tree 5.1m	Tree 25m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Typically closed overstory of Engelmann spruce. Riparian deciduous species present but not dominant.

Class C **70%**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIEN Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	100%
Height	Tree 25.1m	Tree >50.1m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Typically closed, old Engelmann spruce trees. Canopy closure tends to be >60%.

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

Description

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.

Disturbances

Fire Regime Group:** **V**

Historical Fire Size (acres)

Avg 0
Min 0
Max 0

Sources of Fire Regime Data

☑ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	400	250	750	0.0025	99
Mixed					
Surface					
All Fires	400			0.00252	

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

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011620 Western Great Plains Floodplain Systems

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

General Information

Contributors (also see the Comments field) **Date** 4/6/2006

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Modeler 2	Vinita Shea	vinita_shea@blm.gov	**Reviewer**	Steve Cooper	scooper@mt.gov
Modeler 3			**Reviewer**	Linda Vance	livance@mt.gov

Vegetation Type
Wetlands/Riparian

Map Zone
20

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

Dominant Species*

PODE3	CORNU
SALU2	ROSA5
SAEX	PASM
SAAM2	ARCA13

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Great Plains river systems from eastern MT west to the Rocky Mountain front. Such river systems include the Missouri, Mussell, Yellowstone, Teton, Marias and Sun rivers. The major tributaries to these river systems would be in this BpS.

Biophysical Site Description
Alluvial surfaces, usually bare, within broad floodplains are present as low elevation shorelines and barforms. The slightly higher fluvial landform adjacent to the channel forms the first terrace for fluvial dependent species. Over time, laterally migrating point bars form bench platforms that may become late seral stage floodplain forests.

Vegetation Description
Broadleaf deciduous forest dominated by cottonwood (primarily Populus deltoides), yellow willow, or peach leaf willow and sandbar willow. In the Milk River drainages, narrowleaf cottonwood (Populus angustifolia) is common. Narrowleaf cottonwood occurs in upper (intermountain valley) reaches of the Marias and Yellowstone rivers. Black cottonwood (Populus trichocarpa) is found along the Milk and Yellowstone, but only occasionally along the Marias. Early seral stage phreatophytic vegetation becomes established on low elevation flood deposits, however, long-term survival is possible only on bare, moist sites on slightly higher elevation (1-3m above lower limit of perennial vegetation) Other species found in the floodplain riparian zone include sandbar willow and box elder, typically associated with late seral stages. (Green ash is not a late seral stage species in MZ20.) Box elder is more common along the Milk and Marias than along some of the other drainages. Box elder, however, is also seen today in the Musselshell/Missouri River, but it is questionable as to whether that would have occurred historically.

Understory species in these later seral stages may include dogwood, currents, snow berry, wild rose and

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choke cherry.

Disturbance Description

The development and maintenance of this system is dependent on fluvial geomorphic processes such as channel meandering, sedimentation, erosion, channel avulsion and barform accretion driven by hydrologic variability. This variability incorporates the features of timing, duration, frequency, magnitude and intensity. Regeneration of the dominant species (cottonwood and willow) is dependent on flooding and movement of river channels, which creates bare, moist soil needed for seedling establishment. Oxbow and slough development also influence the floodplain system and create variability in plant community composition. Upper terraces have infrequent flooding and scouring events, while the lower terraces nearest the river flood frequently.

Early seral stage development stands are produced on point bars via channel meandering, which occurs most often during moderately frequent high flows. Also produced in other ways - ie, two kinds of rivers - meandering and as well as occurring on areas of sediment deposition - if the river has large flood and a bare area created, then the system is established; or via silt deposit that assists establishment (Scott et al 1996).

Scouring caused by ice jams during the winter, channel meandering, oxbows and slough development greatly influence this system. Ice jams and ice scouring were not modeled.

Changes in hydrology due to the activities of beaver are also an important ecological process in the Great Plains Floodplain, particularly on the tributaries to the Missouri River. Beaver impoundments kill trees (sometimes over large areas) and may create open water habitat, willow stands or contribute to channel meandering. The effects of beaver ponds on forest dynamics in this system are also poorly understood at the landscape level, especially in the presettlement context. Note that beaver populations might have been maintained at artificially low levels on the Great Plains due to constant harvesting by humans. Beaver activity could have been a large influence in this system historically. It could have contributed to the system going from the mid seral stage to the silver stagebrush stage. However, this would happen if they were old stands on higher terraces close to the channel, but not if they were younger stands on lower, moister terraces. Cottonwoods on lower moister terraces would resprout and there would be a willow-cottonwood, beaver-induced disclimax. Beaver damage could be highly extensive in areas in this system (Lesica and Miles 2004; 1999).

Traveling ungulate herds and Native American activities locally impacted seral stage development. However, not enough is known about about such disturbance to attempt modeling.

This seral community is most affected by fluvial geomorphic processes such as flooding, avulsion and deposition, and channel movement. The floodplain valley was modeled up to the last high terrace that rarely floods to reset to an early successional seral stage. The model does include shallow wetlands, sloughs or oxbows. Deep water habitat and the wetted width of the active river were not included in the model. Different flooding regimes were used in the model. The rivers flood to some extent almost every year. This annual, spring, snowmelt flooding is the primary driver of point bar formation. 50-yr or 100-yr floods can wipe out point bars, but they form lots of habitat for cottonwood and willow establishment through scouring and deposition. Minor, point-bar forming floods occur almost every year, while serious, scouring, high-terrace depositing events may be 20-50yrs. Flood frequency is also based on location on the floodplain, with higher terraces being subject to longer flood cycles.

Fire was a disturbance mechanism within portions of floodplain, however, the frequency and intensity is unknown. We can, however infer mixed severity fires in general, given the highly variable species and

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varying fuel amounts and spatial arrangements. The role of fire was less important, with relatively infrequent and patchy, low-to-mixed severity fires. A reviewer (Barrett, personal correspondence) commented that the overall FRI was probably approximately 50-75yrs given the presumably abundant ignition opportunities in the neighborhood (ie, occassional fires spreading into this BpS from adjacent frequently burned grasslands). The overall FRI was thus modeled as such.

Adjacency or Identification Concerns

This system is easily identified by using the flood plain which is covered by a 10yr event. Surrounding vegetation could vary from forested to grass prairie transition. In the western part of MZ20, there could be narrowleaf cottonwood and hybrids between this system and narrowleaf.

Russian olive and tamarisk may be invaders. Tamarisk comes in with cottonwood. Russian olive might affect later successional stages - after 10yrs.

Smooth brome, Canada thistle and Russian knapweed might also invade.

The natural flooding frequencies have been changed by modern water control structures (dam and irrigation projects). Flooding intensity has been altered by construction of small impoundments on tributaries as well as larger impoundments on the main-stem rivers.

Agriculturial activities have change seral development and introduced invasive plant species to the BpS.

Woodcutters along the system operated from the earliest days (1860s) to supply wood to the paddlewheelers plying the river. They cut many of the early stands along the river and perhaps threw the balance to POPDEL regeneration as opposed to ACENEG. It is very difficult to model the presettlement conditions of these river systems, not knowing their original composition.

The best guide for mappers to distinguish between floodplain systems versus riparian systems is the geographic range/ecoregions. The Great Plains Floodplain systems are in the Northwestern Glaciated Plains and the Northern Great Plains; the Rocky Mountain Montane Riparian systems are in the lower elevations (ie, not alpine) of the Northern and Middle Rockies, some of which occur as isolated mountain ranges in the Great Plains. Broadly generalized, the Great Plains Floodplain systems typically have broader floodplains and more terrace development. Also - montane riparian systems of central MT and probably the Black Hills as well will have steeper gradients, narrower floodplains, and be dominated by Populus angustifolia or P. alsamifera as opposed to P. deltoides for Great Plains floodplains. Rivers like the Powder, Tongue and probably Little Missouri start as montane rivers and become Great Plains rivers.

Native Uncharacteristic Conditions

Scale Description

Landscape is adequate in size to contain natural variation in vegetation and disturbance regime. This BpS occurrs in a linear dimension along the Missouri River floodplain, with smaller areas covered in tributary rivers and streams. Wetland complexes include oxbow lakes, slough and marshes.

Issues/Problems

Assumptions: Rapid Assessment model developed with the recognition that the Great Plains Floodplain forest (cottonwood-willow community) is a seral community. This seral community is most affected by fluvial geomorphic processes such as flooding, avulsion and deposition and channel movement. The floodplain valley was modeled up to the last high terrace that rarely floods to reset to an early successional seral stage. The model does include shallow wetlands, sloughs or oxbows. Deep water habitat and the

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wetted width of the active river were not included in the model. Flood frequency for a class is based on location on the floodplain, with higher terraces being subject to longer flood cycles.

Woodcutters along the system operated from the earliest days (1860s) to supply wood to the paddlewheelers plying the river. They cut many of the early stands along the river and perhaps threw the balance to POPDEL regeneration as opposed to ACENEG. It is very difficult to model the presettlement conditions of these river systems, not knowing their original composition.

Comments

This model for MZ20 was adapted from the Rapid Assessment model R4NOFP Great Plains Floodplain created by George Cunningham (gcunningham@mail.unomaha.edu) and reviewed by John Ortmann (jortmann@tnc.org). The model for MZ20 was significantly modified descriptively and quantitatively by Vinita Shea (vshea@blm.gov) and Ben Pratt (ben_pratt@fws.gov). The model is also reflective of the upper Missouri River region. Upon review for MZ20 by Peter Lesica, Brian Martin, Steve Cooper, other major quantitative changes were made and successional classes were changed to encompass the silver sage component of class E instead of a green ash community, which was thought to not exist in MZ20. Other reviewers for MZ20 were Steve Barrett.

Vegetation Classes

Class A **5%**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

Description

Indicator Species* and Canopy Position

PODE3	Upper
SAEX	Upper
SALU2	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0%	100%
Height	Shrub 0m	Shrub 1.0m
Tree Size Class	Seedling <4.5ft	

☑ Upper layer lifeform differs from dominant lifeform.

The upper layer lifeform is comprised of a seedling and sapling shrub (willows) and tree component. Trees might be more abundant/frequent. However, to abide by mapping rules, we used shrubs as the upper layer lifeform. Short trees approximately one meter or less are also in this class.

Created by deposition, stream meander changes, point bar formation and scouring.

The upper layer lifeform is comprised of a seedling and sapling shrub (willows) and tree component. Trees might be more abundant/frequent. However, to abide by mapping rules, we used shrubs as the upper layer lifeform. Short trees approximately one meter or less are also in this class.

Pioneer tree and shrub species of cottonwoods and willows. Herbaceous understory of sedges (bulrushes) and native annuals in wet areas. In this early stage, most of the area is bare sand. Age 0-4yrs, and succeeds to class B, another open stage. Most of area is seasonally flooded. Much bare, wet-alluvium habitat for cottonwood establishment is created each year during spring floods. However, most all of these will be swept away by the next year's flood. It is probably only every 10-20yrs that flooding occurs up high enough on point bars and low terraces to establish cottonwoods and then allow them to escape flooding until they are large enough to persist. This was modeled as alternate succession occuring every 20yrs, and advancing this stage to B.

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Class B 15 %

Early Development 2 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PODE3	Upper
SAEX	Middle
SALU2	Middle
SCHOE6	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	50 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Dominated by young canopy of tree saplings and shrubs. The understory is highly variable and consists of bare sand, annuals or perennial hydrophytes. Species would include various grasses, sedges and rushes. Annuals become less and less common after 4-5yrs as the rhizomatous perennials take hold. This class is aged 5-14yrs and then succeeds to class C, a mid-development closed stage.

SCHOE6 is meant to be Scirpus pungens.

Minor flooding occurs every 20yrs, advancing this stage to the next; deposition causes the terrace to build and become higher and drier. This was modeled as alternate succession. Lack of flooding actually maintains the stage.

Major flooding occurs every 50yrs, bringing it back to class A. This was modeled as wind/weather stress.

Beaver disturbance occurs in this class. The closer to the river, the more likely it is. It was modeled as "optional 1". Beavers, however, do not have as much of an impact in stands less than 10yrs old unless there is nothing else in the area. Beaver activity is quite variable. It was modeled as occuring on one percent of this class on the landscape each year, maintaining this class.

Class C 30 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PODE3	Upper
SAAM2	Mid-Upper
SALU2	Middle
GLLE3	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	70 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

This stage develops as the stand starts to mature. This community tends to be partially open, with scattered cottonwoods and willows. Stands of cottonwoods 20-50yrs old can be fairly dense, although there are usually some openings. The shrub layer is highly variable and may include species such as rose, snowberry, chokecherry and dogwood. Glycyrrhiza lepidota might also occur. Elymus canadensis might also occur. The understory vegetation is highly variable. Age is 15-50yrs, succeeding to class D, a late closed stage.

Flooding occurs every 50yrs, and advances the class to the next stage; flooding promotes the class to the next stage by raising the level of the terrace. Minor flooding leads to deposition. This was therefore modeled as alternate succession. Major flooding occurs every 50yrs, bringing this class back to the early class A stage. This was modeled as wind/weather stress.

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Replacement fires were modeled at occurring every 150yrs. However, it has been suggested that stand replacing fires might not occur in this class because it might be too wet for fire. However, due to lack of data, replacement fires were kept in the model. It is questionable as to whether replacement fire would set this stage back to class A, as the terrace would be too high and dry to provide conditions for successful establishment of cottonwood and willow from seed. If the cottonwoods resprouted, it would be more like class B because the understory would be more mature than class A; if the cottonwoods didn't resprout, it would probably just be a willow stand. Replacement fire was therefore modeled as taking this class to class B.

Low severity and mixed fire also occur every 100yrs, combined, and does not transition to another stage.

Beaver disturbance occurs in this class. The closer to the river, the more likely it is. It was modeled as "optional 1". Beaver activity is quite variable. It was modeled as occuring on one percent of this class on the landscape each year, maintaining this class.

Class D **25%**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PODE3	Upper
PASM	Low-Mid
SYOC	Middle

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	61 %	80 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

This class is a mature, late seral closed canopy cottonwood floodplain forest. Overstory is dominated by cottonwood. (Original MZ20 modelers included box elder ACENEG in this class; however, all other reviewers disagreed and said that ACENEG was a minor component historically. It might be present, but in small amounts; chokecherry is more common; green ash is also not common in riparian cottonwood forests in this mapzone. Box elder, however, is seen today in the Musselshell/Missouri River, but it is questionable as to whether that would have occurred historically.) System becoming drier, so western wheatgrass coming in.

Age 51-200yrs and can then succeed to E.

Minor flooding occurs every 10-20yrs. Minor flooding raises the level of the terrace. Because this is the last stage in this cottonwood portion of the system, this minor flooding was modeled as wind/weather stress, causing no transition. Major flooding occurs every 50-100yrs, bringing this class back to class A. This was modeled as wind/weather stress.

Replacement fire occurs every 150yrs (this interval is speculative, as not much data is available.) and takes this class to E, the silver sagebrush class. It is thought, however, that before it gets to silver sagebrush, there might be an intermediate stage dominated by western wheatgrass and snowberry before silver sagebrush establishes in significant amounts. However, due to the limitations of the five-box model, this intermediate stage was not modeled.

Low severity fire was also modeled as it was in class C, causing no transition. Mixed severity fire was included with the same probability as low severity, every 100yrs. It is thought that mixed severity fire would cause a more open, drier stand that would allow invasion of silver sagebrush earlier, bringing it to E earlier; however, because that type of transition was captured in replacement fire, mixed severity fire was modeled as removing some of the overstory and thus causing a transition to C.

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Optional 2 in this class represents erosional processes of river meandering that would bring this class eventually back to class A. The class/system will first be part of the river, but then will succeed to class A or a point bar state. This occurs with a frequency of several hundred years and was modeled at a frequency of 400yrs.

River meanders back and begins to cut away at the banks whereon a mature or old-growth stand of POPDEL exists and the living trees slowly are undercut and ultimately fall into the stream.

Beaver disturbance occurs in this class. The closer to the river, the more likely it is. It was modeled as "optional 1". Beaver activity is quite variable. It was modeled as occuring on one percent of this class on the landscape each year, maintaining this class.

Class E **25%**

Late Development 2 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

Indicator Species* and Canopy Position

ARCA13	Upper
SYOC	Upper
PASM	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	40 %
Height	Shrub 0m	Shrub 1.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

This class was originally modeled as a green ash community. However, in MZ20, that successional stage does not occur (it occurs further east). Reviewers therefore changed this class as follows:

This is a silver sagebrush climax community on river terraces and larger streams. It has been noted (Cooper, personal correspondence) that the usual case in this system is for plains cottonwood to die out and for the stand to go to silver sagebrush domination with western wheatgrass in the undergrowth or western snowberry and rose (Rosa spp) with grasses (mostly PASSMI). That is what is modeled here. It is thought that before this stage gets to silver sagebrush, there might be an intermediate stage dominated by western wheatgrass and snowberry before silver sagebrush establishes in significant amounts. However, due to the limitations of the five-box model, this intermediate stage was not modeled.

This class also represents the post-replacement fire community from D. If a replacement fire were to occur in D, it would come to this stage - which is why this stage therefore starts at age 50yrs. This is a stable community and it persists. Silver sagebrush resprouts after fire.

This class is less likely to have depositional flooding than other stages. It was therefore not modeled here.

Major flooding events were modeled as wind/weather stress occurring every 250yrs, bringing this class back to A.

Optional 2 in this class represents erosional processes of river meandering that would bring this class eventually back to class A. The class/system will first be part of the river, but then will succeed to class A or a point bar state. This occurs with a frequency of several hundred years and was modeled at a frequency of 400yrs.

Replacement fire was modeled at every 50yrs, similar to other silver sage communities, but maintaining this stage, as this class is stable, as stated above - and the silver sagebrush resprouts and thus maintains this stage.

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Note for mappers: although height and cover overlap with class A, species are completely different. This is no longer a PODE3 community.

Disturbances

Fire Regime Group:** III

Historical Fire Size (acres)

Avg
Min
Max

Sources of Fire Regime Data

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

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	100			0.01	55
Mixed	240			0.00417	23
Surface	240			0.00417	23
All Fires	55			0.01833	

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
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [x] Other (optional 1) beaver
- [x] Other (optional 2) erosional processes of river meandering

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011650 Northern Rocky Mountain Foothill Conifer Wooded Steppe

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

General Information

Contributors (also see the Comments field) **Date** 6/13/2006

Modeler 1	Steve Barrett	sbarrett@mtdig.net	**Reviewer**	Mary Manning	mmanning@fs.fed.us
Modeler 2			**Reviewer**	LaWen Hollingsworth	lhollingsworth@fs.fed.us
Modeler 3			**Reviewer**		

Vegetation Type
Forest and Woodland

Map Zone
20

Model Zone

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

Dominant Species*
PSME JUSC PIFL2 PSSP6 ARTRV FEID JUCO

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Primarily found east of the Continental Divide in northern MT, eastern ID, and WY, but west of Billings, MT. It is thought that this type is very limited in extent in MZ20. The Missouri River Breaks and some ponderosa pine on shale might meet the criteria for this system.

Biophysical Site Description
These savannas occur at the lower treeline/ecotone between forested and nonforested BpSs and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from <500m in British Columbia to 1600m in the mountains of central ID. Occurrences are found on all slopes and aspects; however, moderately steep to very steep southerly facing slopes or ridgetops are most common. This ecological system generally occurs on glacial till, glacio-fluvial sand and gravel, dune, basaltic rubble, colluvium, to deep loess or volcanic ash-derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, rockiness and periods of drought during the growing season. These savannas in the eastern Cascades, Okanagan and northern Rockies regions receive winter and spring rains, and thus have a greater spring "green-up" than the drier woodlands and savannas in the central Rockies.

Vegetation Description
Generally dominated by Douglas-fir with variable cover of ponderosa pine and/or limber pine. The understory is composed of bunchgrasses and sparse shrubs. Stands are typically open and dominated by moderate to large diameter Douglas-fir.

Disturbance Description
Fire regime is predominantly (70%) frequent, low severity fires with a MFI of approximately 20-30yrs. This

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MFI is similar to BpS 1117 Southern Rocky Mountain Ponderosa Pine Savanna, but not quite as frequent. Mixed-severity fires occur with a typical frequency of 30-50yrs primarily in dense stands (classes B and E). Native American burning may have occurred in many of these low-elevation forests.

Adjacency or Identification Concerns

Limber pine and Douglas-fir could be minor associates in this cover type. This BpS corresponds with cool, dry Douglas-fir and limber pine habitat types. It is also within the ecotone with mountain grasslands/sagebrush.

Limber pine may be affected by blister rust.

Native Uncharacteristic Conditions

Scale Description

Since this type is dominated by surface fires and represents an ecotone, patches tend to be smaller in size. Consequently, fire sizes were also relatively small. Analysis areas of several thousand acres would probably be adequate.

Issues/Problems

Comments

This model for MZ20 was adapted from the same BpS in MZ10 created by Jeff Jones (jjones@fs.fed.us) and reviewed by Mary Manning (mmanning@fs.fed.us), Cathy Stewart (cstewart@fs.fed.us) and Carly Gibson (cgibson@fs.fed.us). Descriptive and quantitative changes were made in order to better represent MZ20 and also to better represent each of the classes proportionally.

Additional reviewers for MZ10 were John DiBari (jndibari@yahoo.com), Steve Barrett (sbarrett@mtdig.net) and Lee Clark (lwclark@fs.fed.us).

Based on the Rapid Assessment model R0PSMEdy, by Jeff Jones and reviewed by Cathy Stewart (cstewart@fs.fed.us) and Steve Barrett (sbarrett@mtdig.net).

Rapid Assessment peer review comments incorporated on 3/16/2005, resulting in clarification in description and slightly more surface fires and higher MFI overall.

Vegetation Classes

Class A **20 %**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PSME	Upper
FEID	Lower
ARTRV	Lower
PIFL	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0 %	30 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Dominated by bunchgrasses and mountain sagebrush, and seedling/sapling sized Douglas-fir. Limber pine and ponderosa pine may be present in varying amounts. AGSP can be another indicator species.

This class succeeds to C, a mid-open class after 30yrs. In the absence of fire for 25yrs, however, this class will

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succeed to class B, a mid-closed class.

Replacement and mixed fire were modeled as an overall 20yr MFI split 50/50.

Wind/weather stress occurs with a probability of 0.033 (3% of the landscape each year is affected), taking this class back to its earliest state.

Class B 10%

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PSME	Upper
PIFL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	100 %
Height	Tree 0m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

This class is somewhat of a combination of mid and late closed stages. Trees would become larger later in this stage, although in the first years, they would be mostly pole and possibly medium sized trees on better sites. Relatively dense pole and/or large diameter Douglas-fir as this class progresses through time. Limber pine and ponderosa pine may be present in varying amounts. Sagebrush has largely dropped out of the stand. Mixed severity fire may open up the canopy.

This class can persist.

Replacement and mixed fire were modeled with an overall 20 MFI split 30/70, respectively. Mixed fire brings this class to a mid-open stage.

Insect/disease (probability of .005) and wind/weather stress (probability of .033) occur and cause a transition to a mid-open stage.

Class C 20%

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PSME	Upper
FEID	Lower
ARTRV	Lower
PIFL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	30 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Open poles of Douglas-fir with bunchgrass and sagebrush understory. Limber pine and ponderosa pine may be present in varying amounts. Surface fires maintain the open condition.

This class succeeds to D after 60yrs. However, in the absence of fire for 45yrs, it will succeed to B, a mid-closed stage.

Replacement, mixed and low-severity fire were modeled with an overall 20yr MFI split 10/30/60, respectively. Mixed and low severity fires maintain this stage.

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Insect/disease (probability of 0.001) and wind/weather stress (probability of 0.033) occur but do not cause a transition.

Class D 50 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PSME	Upper
FEID	Lower
ARTRV	Lower
PIFL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	30 %
Height	Tree 10.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Widely spaced, open canopy of medium to large diameter Douglas-fir with bunchgrass and sagebrush understory. Canopy fuel is discontinuous. Limber pine and ponderosa pine may be present in varying amounts. Surface fires maintain the open condition.

Replacement, mixed and low-severity fire were modeled with an overall 20yr MFI split 10/20/70, respectively. Mixed and low severity fires maintain this stage.

Insect/disease (probability of 0.001) and wind/weather stress (probability of 0.03) occur but do not cause a transition.

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:** I

Historical Fire Size (acres)

Avg 0
Min 0
Max 0

Sources of Fire Regime Data

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	100	100	300	0.01	20
Mixed	65	30	100	0.01538	31
Surface	40	15	40	0.025	50
All Fires	20			0.05038	

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.

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**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.

Additional Disturbances Modeled

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

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**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2011670 Rocky Mountain Poor-Site Lodgepole Pine Forest

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

General Information

Contributors (also see the Comments field) **Date** 1/18/2006

Modeler 1	Eric Miller	eric_miller@nps.gov	**Reviewer**	Steve Barrett	sbarrett@mtdig.net
Modeler 2			**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type
Forest and Woodland

Map Zone
20

Model Zone

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

Dominant Species*
PICO CARO5
CAGE2
VASC
CARU

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
Northern Rockies, northwestern WY, Wind River Range, Teton Range and eastern ID subsections M331Aa, M331Ae.

This BpS is thought not to occur in MZ21. It is limited to the subalpine zone, and the highest elevations that would possibly support this system are calcareous, not a suitable substrate.

Biophysical Site Description
This type occurs on coarse, nutrient poor soils derived largely from silicic rocks, (rhyolite, granite and some sterile sandstone). This type may be considered an edaphic climax. These are subalpine forests where the dominance of Pinus contorta is related to topo-edaphic conditions and nutrient-poor soils. These include excessively well-drained pumice deposits, glacial till and shallow moisture-deficient soils with a significant component of volcanic ash. Soils on these sites are typically well-drained, gravelly, coarse-textured, acidic and rarely formed from calcareous parent materials. Annual precipitation averages 600-900mm with fairly even distribution across the months.

Vegetation Description
Following stand-replacing fires, Pinus contorta rapidly colonizes and develops into dense, even-aged stands. Regeneration is accelerated where serotiny is characteristic. Following stem exclusion, understory trees increase and may include subalpine fir and Engelmann spruce, in wetter areas, or commonly whitebark pine at higher elevations and drier sites. Lodgepole pine occurs in nearly pure stands throughout all successional stages (ie, lodgepole pine plays early-seral and quasi-climax roles in this system). These stands can be dense (80-100sq ft basal area) and can have densities greater than 150sq ft basal area. Understory herbaceous and advanced regeneration layers will typically be sparse except in canopy gaps. Species typically include: Geyer's sedge, Ross' sedge, grouse whortleberry and pine grass. Early succession stands

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can be dense with lodgepole pine seedlings and saplings that thin over time to widely spaced trees with a multi-aged structure. However, reviewers state that very dense lodgepole pine stands can remain at high densities throughout their succession.

Disturbance Description

Most fires remain small (less than one hectare) and naturally extinguish. The stand-replacing fire regime is driven more by weather events than fuel accumulation (Bessie and Johnson 1995, Schoennagel, et al. 2004). Older stands are more disposed to stand-replacing fire (Renkin and Despain 1992). Spotting and crowning are more important than surface spread during large fire events. Young stands generally lack litter or live herbaceous/shrubby fuel to sustain surface spread. Where young stands have been observed to burn, fire spread is carried by thick elk sedge culms. Surface spread in mature stands is slow, erratic and patchy in compacted needle litter and dispersed heavy fuel jackpots. The live herbaceous and live shrubby fuel component contribute little to fire spread. Romme (1982) found a fire return interval of 300-400yrs for stand-replacing events in the Little Firehole drainage in Yellowstone. Although surface and mixed severity fires are much more frequent, they remain small <50ha and most less than one hectare. Thus any given point on the landscape is much more likely to burn in a stand-replacing fire than a surface or mixed severity fire. Another reviewer, however, commented that a 350yr replacement fire MFI might be too long for densely spaced stressed trees.

In the VDDT model, replacement fire was modeled with an average FRI of 325yrs, whereas mixed fire was modeled at 600yrs, for an overall FRI of 210yrs. This conceivably is too low of an FRI (too much fire), and the overall FRI should be approximately 300yrs, with the majority being replacement fire. This assumption is based on the rest of this disturbance description.

Mountain pine beetles kill trees in endemic and epidemic disturbance events. Large diameter trees (>20cm DBH) are preferred by mountain pine beetles but in epidemics, 13cm DBH class trees have been known to be killed. Generally younger trees are not host trees. Patches of mortality provide gaps for regeneration. Mistletoe may cause mortality in older trees and greater susceptibility to mountain pine beetle; and the profusion of induced branches and partial crown mortality, may predispose them to torching. Shallow root systems are prone to wind-throw.

This is generally a non-equilibrium system which is highly variable, with fire mainly controlled by the weather and climatic changes.

Reviewers suggested not modeling low-severity fire since the effects are minimal. They also recommended leaving out much of the insect effect and alternative succession, since little data is available.

Adjacency or Identification Concerns

May be confused with dense stands of lodgepole pine dominated seral stages of more moist or andesitic subalpine forested environments (eg, BpS 1050; Despain 1990). This type corresponds to cool habitat types where lodgepole pine is the indicated climax species (Pfister et al. 1977).

This is a non-equilibrium ecosystem which is highly variable and likely not out of its historical range of variability (Romme, personal correspondence).

Native Uncharacteristic Conditions

None.

Scale Description

Patch size ranges from a few hectares to a few hundred on sandstone outcrops to areas of thousands to tens

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of thousands on rhyolite and granitic substrates. The Yellowstone Fires of 1988 included 50000ha+ of this forest type, however 1000ha would be a large fire.

Issues/Problems

Comments

This model for MZ20 was adopted as-is from the same BpS in MZ21 created by Eric Miller and reviewed by Liz Davy, Spencer Johnson and Bill Romme. Only descriptive additions were made for MZ20, as this type is thought not to occur in MZ20. However, model for MZ21 was adopted, since Yellowstone Plateau has the appropriate substrates of nutrient poor rhyolite.

This model for MZ21 is based on the LANDFIRE model for the same BpS 1167 from MZ10 created by Dana Perkins (dana_perkins@blm.gov), Carly Gibson (cgibson@fs.fed.us) and John DiBari (jdibari@email.wsu.edu) and reviewed by Lynn Bennett (lmbennett@fs.fed.us), Steve Barrett (sbarrett@mtdig.net) and Roy Renkin (roy_renkin@nps.gov). Quantitative and descriptive changes were made to the model for MZ21; fire intervals and other disturbance intervals were modified. There was one additional anonymous reviewer for MZ21.

Additional reviewer for MZ10 was Ward McCaughey (wmccaughey@fs.fed.us). Peer review in MZ10 resulted in a longer overall MFI (from 175yrs to 300yrs) and a significant reduction in the amount of mixed severity fire (from ~40% to ~10%). There was some debate among reviewers about the exact nature of this BpS compared to subalpine, seral lodgepole pine. Additional adjustments were made in the model description to clarify these differences.

Model for MZs 10 and 19 was based on the Rapid Assessment model R0PICO by Don Despain (don_despain@usgs.gov) and reviewed by Steve Barrett (sbarrett@mtdig.net) and Cathy Stewart (cstewart@fs.fed.us).

Vegetation Classes

Class A 15%

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PICO	Upper
CAGE2	Lower
CARO5	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Sparse to dense lodgepole pine seedlings to young pole-sized trees. Herbaceous ground cover mostly of Carex geyeri, C. rossii and early successional annuals and colonizers. Lodgepole pine are slow growing, and succession to class B, mid-closed stage, occurs after 40yrs.

Some poorer sites may succeed to a mid-open state, but this was not modeled due to lack of data.

Replacement fire occurs every 300yrs, and mixed fire occurs with a probability of 0.001 per year. Reviewers stated that mixed fire occurs more often since there is fine fuel available every 200yrs and are kept in class A.

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Class B 20 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PICO	Upper
CAGE2	Lower
CARO5	Lower
VASC	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Mid to large sized lodgepole pine with a sparse herbaceous layer and high canopy closure and stem exclusion. Most ground cover is litter. Grouse whortleberry, if present, steadily increasing.

Disturbance caused canopy gaps (modeled as wind/weather/stress) may cause a transition to class C with a probability of 0.001.

Competition in the dog-hair condition may delay succession and prolong stay in this class, with a probability of 0.001. Self-thinning might also cause a transition to C. This was also modeled as "competition/maintenance," although originally modeled as "alt succ," with a probability of 0.01, as per reviewers' suggestions.

Insect outbreaks occur with a probability of 0.001, taking this class to a mid-open state.

This class succeeds to class D after 150yrs.

Replacement and mixed fires are modeled occuring with the same probability of that in class A. Mixed fires take this stage to an open stage.

This class was originally modeled with canopy and height identical to class D, 41-100% and 10-25m height. Modelers and reviewers felt that tree height doesn't seem to change much once the lodgepole stands reach maturity and the canopy cover for both falls within the specified range of 41-100%. The differences have more to do with influx of advance regeneration, decreasing tree density with time, increasing canopy bulk density, decreasing canopy base height and increasing surface fuel loading. Depending on where these sites are (better sites taller trees), will determine how tall the trees are. But due to modeling rules, class D height was changed.

Class C 45 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PICO	Upper
CAGE2	Lower
CARO5	Lower
VASC	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	40 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Mid to large-sized lodgepole pine with a higher herbaceous and shrub component. Grouse whortleberry, if present, increasing in cover. Some poorer sites may succeed directly from an open A condition, but this was not modeled due to lack of data. At 150yrs, this class succeeds to class D, a late-closed stage.

Competition may delay succession and prolong stay in this class, with a probability of 0.001.

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Replacement and mixed fire occur with the same probability as in B. Although surface fires were originally modeled, they were removed due to very low frequency and effects, as per reviewers.

Review for MZ20 questioned whether more closed stands (class D) would have existed versus open stands (class C), as opposed to how this model attributes the percentages.

Class D **20 %**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PICO	Upper
CAGE2	Lower
CARO5	Lower
VASC	Lower

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	41 %	100 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Nearly homogenous even aged or uneven aged lodgepole pine stands with limited recruitment in gaps. Includes the non-pyrogenous climax lodgepole pine (Despain 1983). Understory herbaceous cover is sparse and limited to where there is sunlight.

Blowdowns result in opening and the transition to class C with a probability of 0.002.

Mountain pine beetle infestations at epidemic levels may cause transitions. Endemic population levels of beetles occur with a combined probability of 0.01; some outbreaks take the class back to an early state, with a probability of 0.005, and some outbreaks take the class back to a mid-open state, also with a probability of 0.005.

Small, patchy surface fires may occur; however, due to very low frequency and effect, they were not modeled, as per reviewers. Large, crown fires result in A every 300yrs, while mixed fires occur every 200yrs.

This class was originally modeled with canopy and height identical to class B, 41-100% and 10-25m height. Modelers and reviewers felt that tree height doesn't seem to change much once the lodgepole stands reach maturity and the canopy cover for both falls within the specified range of 41-100%. The differences have more to do with influx of advance regeneration, decreasing tree density with time, increasing canopy bulk density, decreasing canopy base height and increasing surface fuel loading. Depending on where these sites are (better sites taller trees), will determine how tall the trees are. In order to accommodate the modeling/mapping rules, the tree height was raised in this class to 25m and higher; however, modelers and reviewers felt that this class could contain shorter trees.

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:** V

Historical Fire Size (acres)

Avg 1
Min 1
Max 800000

Sources of Fire Regime Data

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

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	325	100	400	0.00308	65
Mixed	600	200	4000	0.00167	35
Surface					
All Fires	211			0.00475	

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
- [ ] Native Grazing
- [x] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

References

Barrett, S.W. 2004. Altered fire intervals and fire cycles in the Northern Rockies. Fire Management Today 64(3): 25-29.

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Renkin, R.A. and D.G. Despain (1992) Fuel moisture, forest type, and lightning-caused fire in Yellowstone National Park. Canadian Journal of Forest Research 22: 37-45.

Romme, W.H. 1982. Fire and landscape diversity in subalpine forests of Yellowstoe national Park. Ecological Monographs: 52(2): 199-221

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Schoennagel, T, T.T. Veblen and W.H. Romme. 2004. The interaction of fire, fuels and climate across Rocky Mountain Forests. BioScience 54(7): 661-676.

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**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.

LANDFIRE Biophysical Setting Model

Biophysical Setting: 2013850 Western Great Plains Wooded Draw and Ravine

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

General Information

Contributors (also see the Comments field) **Date** 6/9/2006

Modeler 1	Peter Lesica	peter.lesica@mso.umt.edu	**Reviewer**	Brian Martin	bmartin@tnc.org
Modeler 2			**Reviewer**	Linda Vance	livance@mt.gov
Modeler 3			**Reviewer**	Steve Barrett	sbarrett@mtdig.net

Vegetation Type
Wetlands/Riparian

Map Zone
20

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

Dominant Species*

FRPE	SYOC
ULAM	CASP7
ACNE2	RIBES
PRVI	TORY

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

Predominately west of the Missouri River in ND and SD, with minor extensions east of the Missouri River and south into NE and in eastern and southeastern MT.

It occurs in upland draws and ravines scattered throughout the Northern Mixed Grass Prairie and Northern Great Plains Steppe.

This BpS is thought to be very limited in abundance within this MZ20. This occurs primarily around the island mountain ranges, such as the Highwoods and Little Rockies. Some of these occur around Glasgow, but is very limited especially in western portion of mapzone. This type does occur in MZ29 and 30 prominently.

This would occur in MZ20 in subsection 331La.

Biophysical Site Description

This BpS occurs in drainage ways that rarely have running water but trap snow during the winter, with extensions onto steep north-facing slopes. It's more common in landscapes with more topographic relief due to hydrology. There is very little running water in these systems, as in Badlands topography. The vegetation type is best developed in topographic conditions that have favorable hydrology - sometimes steeper and deeper depressions have better moisture because of groundwater and snow deposition. This BpS is heavily influenced by topographic situations that produce a combination of deeper soils, supplemental moisture from run-off and snow catchment. Soils are silty and deep.

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In MT, this BpS is typically found in narrow ephemeral drainages, usually at the head of the draw but sometimes in downstream areas. They are often features of dissected landscapes, especially in the Little Sheep Mountains near the edge of MZ20, and in those parts of the state included in MZ29.

Vegetation Description

Intricate mix of western grassland and shrubland species, with elements of eastern deciduous woodlands. Northern extent occasionally supports quaking aspen, while southern extent supports Juniper species.

Berberis repens also occurs. Other shrubs include Crataegus spp, Ribes spp and Prunus americana.

Other forbs include Viola canadensis, Smilacina stellata, Galium aparine and Thalictrum spp.

Disturbance Description

The Wooded Draw BpS forms an intimate association with adjacent mixed grass prairie and shrublands where non-replacement fires through the treed portions are relatively frequent because of productive grass fuel and cycles of moisture and drought. Fires could go through the tree stands without topkill. Sometimes, however, even with topkill of all trees in this system, occassionally the trees regenerate, though occassionally they do not (Lesica, personal correspondence - studies). The regeneration from seeds was not modeled due to lack of data. Only regeneration from stumps is considered for the model. Because seeds of green ash are very strong growers, it could be that they have the same successional stages as regeneration from stumps. However, again, there is not enough data at this time.

Information on fire regimes in this system is rare. Fires were probably frequent because they were frequent in the surrounding grasslands. Severity was variable; mortality of green ash probably varied from 0-100%. Green ash is more likely to resprout after fire where it is a deeper, narrower draw in steeper terrain compared to a broad level draw. Resprouting after fire most likely depends on the vigor of the trees, so that young trees or trees with better water relations are more likely to sprout after fire (Lesica, pers comm). Less frequent replacement fires were generally associated with periods of exceptionally high moisture conditions immediately followed by severe dry conditions. More open stands also tend to be drier and are prone to more severe fires.

Native ungulates play a role in stand regeneration on sites where deer and elk concentrate for food, cover and shelter. It is thought that bison did not spend much time in this BpS type due to topograhpy type. Many trees in this system regenerate from sprouts. Deer heavily browse on stump sprouts and select green ash and rarely forage on snowberry. There is a large interplay between deer populations and vegetation regeneration of trees.

Drought and moist cycles are major factors that interact with both fire and native grazing.

Trees in this BpS often are infected by heartrot resulting in limb breakage. This tends to keep the canopies open where this is prevalent. As one moves west and it gets drier, there is more heartrot; consequently there are more open stands as one proceeds further west (Lesica et al 2003).

There were probably some flooding disturbances in this system. Snowmelt deposits, thunderstorms - localized precipitation events - promote more regeneration from seeds. Green ash seed recruitment occurs following disturbance. Disturbance promotes recruitment as green ash does well in bare soil.

Reviewer for Rapid Assessment noted that Rocky Mountain locust eruptions presumably occurred with severe impacts although the frequency of these eruptions is unknown.

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Adjacency or Identification Concerns

There might be intermediates of this type of green ash draw and cottonwood stands.

Might not burn as well due to over-grazing of adjacent grasslands, although this is just speculation.

Poor livestock management and overgrazing causes loss of tree regeneration and reduction of shrub component and understory dominance by exotic rhizomatous grasses - smooth brome and Kentucky bluegrass. Tree regeneration is less likely in competition with these grasses than in a sedge/forb-dominated native understory. Leafy spurge also occurs.

In the Badlands, this system might start to merge into juniper draws. However, this is not an issue in most areas for this system.

Native Uncharacteristic Conditions

Scale Description

Western stands are usually relatively small (<50ac). Larger areas, 50-100ac, occur infrequently on the eastern edge of distribution. Long, linear corridors - could be <50m wide but snake through landscape for many miles. It's not necessarily a continuous system, however. Dendritic scale. This is somewhat like riparian scale.

Fires probably tended to be patchy because of topographic relief.

Issues/Problems

Long, linear nature of distribution makes them difficult to map. Consequently, they are often listed as a complex in relatively small-scale mapping efforts.

Comments

This model for MZ20 was adapted from the Rapid Assessment model R4WODR Northern Great Plains Wooded Draws and Ravines created by Jack Butler and Stefanie Wacker and reviewed by John Ortmann. For MZ20, major descriptive and quantitative changes were made in order to represent MT better. The MZ20 model was changed to a three-box model.

Vegetation Classes

Class A **20 %**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

Indicator Species* and Canopy Position

CASP7	Lower
SYOC	Upper
PRVI	Upper
	Lower

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	21 %	80 %
Height	Shrub 0m	Shrub 1.0m
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

This class is dominated by shrubs. Cover averages approximately 50%, and the minimum cover would never be as low as 0%. In the first year, herbaceous species might dominate. The herbaceous cover is high underneath the shrubs. The herbaceous cover would probably be 25-50% cover. This class succeeds to B after approximately 10yrs.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 is similar to a snowberry rose coulee type. It contains chokecherry, snowberry with a mesic understory of CASP7 and various woodland forbs and poison ivy.

The transition from A to B could be retarded by native ungulate browsing. Grazing would set this stage back to its beginning state. Grazing, however, is dependent on weather cycles, as well. Deer select green ash. There is also elk browsing.

The combined effect of drought and grazing was modeled as Optional 1. It was modeled to occur on 10% of this class on the landscape each year, setting succession back to zero.

Grazing alone was modeled as occurring on 25% of the landscape each year, but maintaining the class and not causing a transition.

The FRIs are similar to grassland systems. Replacement fire occurs every 15yrs.

Class B **15%**

Mid Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PRVI	Mid-Upper
SYOC	Low-Mid
CASP7	Low-Mid
FRPE	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	50 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Description

This class is dominated by shrubs and trees and is a mid-development stage. Its ages are 10-29yrs. Trees are coming in and getting taller in this stage. Trees are growing approximately 2/3 of a foot each year. A 30% canopy cover of trees would be the average (Lesica 2001). This stage reaches approximately 30yrs of age. It is similar to class A, but the shrubs are taller, and the trees that are coming in, are beginning to overtop the shrubs. A true tree canopy has not yet developed.

The FRI is similar to that in a grassland system, although this system might experience somewhat less frequent intervals, as occassionally fires might not burn through this stage. Some will be replacement fires and take out all of the stand, although this would be less frequent and would also depend on the year and drought. Some fires might maintain the stand. Most of the fires would be mixed and low severity, although the frequency of types would be the same. There would be less mortality on larger trees. During episodes of drought and grazing, there would be no fuel present for fire. Fire was therefore modeled at an overall frequency of 20yrs, but split 30/50/20 percent between low, mixed and replacement fires. The low and mixed fires do not cause a transition to another stage.

The combined effect of drought and grazing was modeled to occur on 10% of this class on the landscape each year, but not causing a transition, and rather maintaining this class.

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**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.

Class C **65%**

Late Development 1 All Structures

Indicator Species* and Canopy Position

FRPE	Upper
PRVI	Mid-Upper
SYOC	Middle
CASP7	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21%	80%
Height	Tree 5.1m	Tree 10m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model

Description

This class begins at approximatelly 30yrs old and persists. This includes both open and closed stages of this system in this age range. An average canopy closure would be approximately 50%. Height can be between 40-70ft and approximately 45in DBH (USDA Forest Service 2002), although most old-mature ash trees in this type in Montana are 20-40ft high with a basal diameter of 20-30in. Tree canopy in this stage is now formed. It takes on aspects of a woodland instead of a shrubland (the first two classes are more shrub communities).

The FRI is similar to that in a grassland system, although this system might experience somewhat less frequent intervals, as occassionally fires might not burn through this stage. Some will be replacement fires and take out all of the stand, although this would be less frequent and would also depend on the year and drought. Some fires might maintain the stand. Most of the fires would be mixed and low severity, although the frequency of types would be the same. There would be less mortality on larger trees. Fire was therefore modeled at an overall frequency of 20yrs, but split 30/50/20 percent between low, mixed and replacement fires. The low and mixed fires do not cause a transition to another stage.

The combined effect of drought and grazing was modeled to occur on 10% of this class on the landscape each year, but not causing a transition, rather, maintaining this class.

Disease might occur in this stage, which opens the stand (Lesica et al. 2003). In MT, this is more prominent than in the Dakotas. In the Dakotas, canopy closure could be 90%. In MT, open canopy would be about 40-45%, and the relatively open nature of stands is probably due, in large part, to high rates of heart-rot disease. Disease is not as common further east, in the Dakotas, NE, etc, and as one gets further east into higher precipitation zones. In the east, canopy cover would be higher and more closed. Disease was modeled as occuring on 20% of this class each year and causing no transition - just keeping it a more open stand. It does not cause a transition to another stage (ie, B), however, because it was questionable as to whether the disease-caused, open, mature stand would be the same as the 9-30yrs old stand.

Class D **0%**

[Not Used] [Not Used]

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.

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.

Class E **0%**

[Not Used] [Not Used]

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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.

Disturbances

Fire Regime Group:** I

Historical Fire Size (acres)

Avg 50
Min 5
Max 100

Sources of Fire Regime Data

☐ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals	*Avg FI*	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	50	30	100	0.02	38
Mixed	50			0.02	38
Surface	80	10		0.0125	24
All Fires	19			0.0525	

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) grazing and drought together
☐ Wind/Weather/Stress ☐ Competition ☐ Other (optional 2)

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**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.

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LANDFIRE Biophysical Setting Model

Biophysical Setting: 2014950 Western Great Plains Depressional Wetland Systems

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

General Information

Contributors (also see the Comments field) **Date** 5/5/2006

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Modeler 3			**Reviewer**		

Vegetation Type

Upland Grassland/Herbaceous

Map Zone

20

Model Zone

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

Dominant Species*

PASM ELPA3
DISP JUBA
HOJU PUCCI
ELAC SPAI

General Model Sources

☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

This occurs throughout lowland low elevation areas of MZ22. These are wetlands that are saline playas. This model might also be used for MZ29. This system is very uncommon in MZ20.

Biophysical Site Description

The closed depression wetland has communities associated with the playa lakes in the southern areas of this province and the rainwater basins in NE characterize this system. They are primarily upland depressional basins. This hydric system is typified by the presence of an impermeable layer such as a dense clay, hydric soil and is usually recharged by rainwater and nearby runoff. They are rarely linked to outside groundwater sources and do not have an extensive watershed. These closed depression wetland sites on the unglaciated great plains (ie, not prairie potholes) that are not Western Great Plains Saline Depressions CES303.669 are few and far between in MZ20.

In the open freshwater depression wetland, the system is composed of lowland depressions and also occurs along lake borders that have more open basins and a permanent water source through most of the year except during exceptional drought years. These areas are distinct from Western Great Plains Closed Depression Wetland (CES303.666) by having a large watershed and/or significant connection to the groundwater table. The system includes submergent and emergent marshes, and associated wet meadows and wet prairies. These types can also drift into stream margins that are more permanently wet and linked directly to basin via groundwater flow from/into the pond or lake.

Vegetation Description

In MZ20, vegetation is dominated by sparse to dense cover of graminoids, up to one meter tall, although typically 0.6 m or shorter. Pascopyrum smithii usually dominates, with Distichlis spicata, Hordeum jubatum, Eleocharis acicularis or Eleocharis palustris almost co-dominant. Juncus balticus will be present in

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areas where water stands for longer after a storm or where flooding occurs. Other graminoids include Puccinellia nuttalliana, Bouteloua gracilis, Koeleria macrantha and Hesperostipa comata. Spartina gracilis has been documented in MZ20 but only in limited areas. Woody plants are rare, except for occassional Gutierrezia sarothrae, Artemisia frigida, Artemisia cana or Symphoricarpos occidentalis.

For MZ22, there is inland saltgrass, alkali sacaton, alkali cordgrass and Rocky Mountain glasswort. Vegetation is occurs in zones from the center of the depression and is dependent on the gradient of the depression. Other dominant species could be SPGR and SARU.

Disturbance Description

Plant communities providing saltgrass habitat are diverse and exhibit a wide range of fire frequencies. Saltgrass is found in desert shrub communities that have fire return intervals of <35yrs to over 100yrs (Hauser 2006).

Prior to land use changes, grassland communities where saltgrass occurs burned regularly. While there is relatively little fire frequency information available on the time prior to the 1880s, it is estimated that fire occurred every 7-10yrs (Hauser 2006). However, the saltgrass in this BpS is in a wetland system and is therefore thought to burn much less frequently. Also, some of the wet clay and salt acts as a fire retardant. There is also little litter in these systems (Roche, pers comm).

Historical fire size is very dependent upon the surrounding vegetation.
The minimum would be one acre. The maximum would be around 200ac. The average would be eight or nine acres. Logic is that if the average playa is about 10ac, the whole thing would rarely burn because of the wetness at the center --so say 80-90% of the playa would burn. Because the surrounding grasslands have an FRI of 10-20yrs, it was thought that small playas or depressional wetland systems would have similar FRIs, because the fire would just move over them. However, if the playa/system is larger - ie, over an acre, then it would be less likely to burn. Therefore, an overall FRI, considering both scenarios, was chosen to be 50yrs.

Return interval for fire could be extended by ungulate grazing.

Spartina gracilis, when present, can withstand fire because of deep rhizomes.

Episodic disturbance is caused by insect infestation (grasshoppers, range caterpillars and Mormon crickets). This was not modeled.

Grazing by native ungulates such as buffalo and antelope can occur. During droughts, ungulates congregate in these areas.

Adjacency or Identification Concerns

Adjacent to western great plains shortgrass and mixedgrass prairies, saltgrass meadow, greasewood shrubland, mixed desert shrubland and big sagebrush steppe. (Knight 1994).

Large concentrations of ungulates could increase the percent of the landscape dominated by shrubs and forbs compared with reference conditions. Fire return intervals are now in the range of 30yrs+.

Since the early 1900s, fire has been excluded and nonnative species such as Japanese brome (Bromus japonicus), smooth brome, Kentucky bluegrass, crested wheatgrass (Agropyron cristatum) and Canada thistle (Cirsium arvense) have taken a strong hold in the Great Plains mixed-grass prairies where saltgrass occurs (Hauser 2006).

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Native Uncharacteristic Conditions

Scale Description

Documentation from outside of MZ22 says playas range from two acres to 800ac with an average of 17ac. For MZ22, big playas are non-existent --so the average would probably be smaller --maybe about 10ac. For MZ20, calling them playas is stretching the definition. We see these little semi-saline playa-type wetlands here and there but they are rarely much more than two acres. However, there are large alkali lakes in parts of the state, although these are much more saline.

Historical fire size is very dependent upon the surrounding vegetation.
The minimum would be one acre. The maximum would be around 200ac. The average would be eight or nine acres. Logic is that if the average playa is about 10ac, the whole thing would rarely burn because of the wetness at the center --so say 80-90% of the playa would burn.

Issues/Problems

Concentrations of ungulates could increase the percent of the landscape dominated by shrubs and forbs compared with reference conditions.

Comments

This model for MZ20 was adapted from the draft model for the same BpS from MZ22. Descriptive changes were made to reflect the system within MZ20 and to more fully describe the system.

This model for MZ22 was adapted from the model from BpS 1149 in MZ28, which was an adjacent western Great Plains shortgrass prairie model. Quantitative and descriptive changes were made, and this is in essence a new model. Therefore, comments and modeler and reviewer names from 281149 have been removed.

Vegetation Classes

Class A **35%**

Early Development 1 All Structures

Upper Layer Lifeform

- ☑ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model 1

Indicator Species* and Canopy Position

PASM	Upper
DISP	Upper
HOJU	Upper
ELAC	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0%	20%
Height	Herb 0m	Herb 0.5m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Dominated by resprouts and seedlings of grasses and post-fire associated forbs. Low to medium height with variable canopy cover. For MZ22, indicator species could also be PUCCI and SPAI.

Persists for 20yrs and then succeeds to class B, a mid-development closed stage.

Native grazing and herbivory could be heavy (10% of this class each year).

Replacement fire occurs every 50yrs, which is somewhat shorter than the FRI of an adjacent grassland community. Since this is a wetland community, it is thought that fire would impact the landscape much less frequently.

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Class B **65%**

Mid Development 1 Closed

Upper Layer Lifeform

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

Fuel Model 1

Indicator Species* and Canopy Position

PASM	Upper
DISP	Upper
PUCCI	Upper
HOJU	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	30 %
Height	Herb 0m	Herb 1.0m
Tree Size Class	None	

[x] Upper layer lifeform differs from dominant lifeform.

Scattered shrubs may be present.

Description

Greater than 30% herb and shrub cover combined. For MZ22, indicator species could also be SPAI and SARU.

Native grazing and herbivory could be heavy (20% of this class each year).

Replacement fire occurs every 50yrs, which is somewhat shorter than the FRI of an adjacent grassland community. Since this is a wetland community, it is thought that fire would impact the landscape much less frequently.

Class C **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 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

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**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.

Disturbances

Fire Regime Group:** IV

Historical Fire Size (acres)

Avg 10
Min 1
Max 200

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	50	10	100	0.02	100
Mixed					
Surface					
All Fires	50			0.02002	

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

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**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.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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.