LANDFIRE Biophysical Setting Model

Biophysical Setting 2211410 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

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Vegetation Type
Upland Grassland/Herbaceous

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Dominant Species
PSSP6
NAVI4
PASM
HECOC8
SCSC
KOMA
POSE
BOGR2

Map Zone
22

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

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 MZs 29 and 30. It occurs predominantly depending on

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soil types and precipitation zones. It typically does not occur within mountain subsections.

This is probably a very minor component of MZ22. It could conceivably even be dropped for MZ22. The few plots that might be getting assigned to this type are probably along the eastern edge of MZ22, perhaps occurring in subsection 331Gb.

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, 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 (USDA-NRCS 2004), 5i8A and 60B (USDA-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 and rhizomatous grasses (western and thickspike wheatgrass, etc.) dominate the visual aspect of the community, though bunch grasses (bluebunch wheatgrass, bluebunches and needle grasses, etc.) often comprised more than 50% of the community composition. Thickspike wheatgrass (Elymus macrourus) (on lighter soils) is also present; western wheatgrass among others (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, rabbitbrush, fringed sagewort, western

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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 claypan soils).

The most common shrub is silver sagebrush and 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.

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 Veg 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, fire frequency and fire 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 (eg, 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

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than currently defined, but modelers 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.

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's 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 big sagebrush, silver sagebrush, western snowberry, rabbitbrush and fringed sagewort) increase greatly over the historic plant community. Compare 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, and sanders 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.

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.

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In MZ20, historically, this BpS could also have extended throughout the subsections for 331K; in present, 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.

For MZ22, it was suggested that this type be dropped. Therefore, the description and model weren't changed to apply to MZ22, as it would apply to only a very small portion of the zone and therefore did not warrant extra modeler/reviewer time.

Native Uncharacteristic Conditions

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 -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.

For MZ22, it was suggested that this type be dropped. Therefore, the description and model weren't changed to apply to MZ22, as it would apply to only a very small portion of the zone and therefore did not warrant extra modeler/reviewer time.

Comments

This model was adopted as-is from the same BpS in MZ20 developed by Shannon Downey, Steve Cooper and Jeff DiBenedetto and reviewed by Steve VanFossen, Jon Siddoway, Brian Martin and others listed below. Few changes were made for MZ22, as it was thought that this system occuppied such a small amount of the mapzone that it was not worth the effort.

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).

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Vegetation Classes

Class A **70 %**

Early Development 1 All Structure

Upper Layer Lifeform

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

Fuel Model

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		

- [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.

Description

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 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 immediately 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 in Glaciated Plains at 0-5% cover, but not on shallow clay sites or dense clay sites, sands, saline upland, saline lowland, subirrigated and 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

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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

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		

☐ Upper layer lifeform differs from dominant lifeform.

Description

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 (Option 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 is 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 Optional 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 Sandberg bluegrass, buffalograss in southern portions, junegrass). This should be distinguished from the 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 midgrass 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 Northern 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

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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		

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

Shrubs can be present at 20% cover. Common shrubs - silver sagebrush, winterfat, fringe sagewort and 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 and grama grasses.

Shrubs can be present at 20% cover, 0-0.5 meters. Grasses are still the dominant species, with patches of shrubs increasing in abundance under longer term fire intervals.

We would only expect to see approximately five percent 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 in Glaciated Plains at 0-5% cover,but not on shallow clay sites or dense clay sites, sands, saline upland, saline lowland, subirrigated and 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.

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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:** **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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