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Northwestern Great Plains Mixedgrass Prairie

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Herbaceous

Map Zone

20

Geographic Range

This vegetation group covers the northern prairies east of the Rocky Mountains from north central Montana to southeastern Montana and northeastern Wyoming.

This Biophysical Setting (BpS) occurs in every section throughout map zone (MZ) 20. 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 Montana. This BpS also resides in MLRA53A Northern Dark Brown Glaciated Plains, Northern Rolling High Plains, MLRAs 58 A,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.

Biophysical Site Description

Elevations range from 1,900-4,000ft. 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, personal communication).

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.

LANDFIRE National 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, personal communication). 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). Grama grasses, rhizomatous grasses (western and thickspike wheatgrass, etc.) dominate the visual aspect of the community, though bunchgrasses (bluebunch wheatgrass, bluebunches, needle grasses, etc.) often comprised >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 >17in (Ashland Ranger District). Prairie sandreed and upland sedges occupy sandy textured soils throughout MZs 29 and 30. Bluebunch wheatgrass is more prevalent within Wyoming and eastern Montana 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 <5% cover. Most of the ground surface is covered, and bare ground is <10% on more mesic sites and 20% on more xeric sites (e.g., glacial till and claypan soils).

The most common shrub is silver sagebrush, which resprouts after fire.

In pre-European 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 prickly pear.

Current conditions are different -- please see Identification Concerns or Issues/Problems boxes.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
PSSP6	<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass
NAVI4	<i>Nassella viridula</i>	Green needlegrass
PASM	<i>Pascopyrum smithii</i>	Western wheatgrass
HECOC8	<i>Hesperostipa comata ssp. comata</i>	Needle and thread
SCSC	<i>Schizachyrium scoparium</i>	Little bluestem
KOMA	<i>Koeleria macrantha</i>	Prairie junegrass
POSE	<i>Poa secunda</i>	Sandberg bluegrass
BOGR2	<i>Bouteloua gracilis</i>	Blue grama

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

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 MZ (VanFossen, personal communicatino).

Historically, the fire return interval (FRI) 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

northcentral part of Montana, 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 >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 5yrs. Short-term precipitation variability may also influence species productivity.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	12	100	2	40
Moderate (Mixed)				
Low (Surface)				
All Fires	12	100		

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

Historically, natural grazing and fire generally encompassed 100s to 100,000s of acres. Repeated heavy animal impact such as prairie dog towns occurred at the scale of 10s to 1,000s of acres, as well as ungulate impacts -- bison.

A negative exponential distribution probably best describes the historic fire size distribution, with a large number <1ha, median 10-100ha, mean 1,000-10,000ha, a low frequency of 50,000-100,000ha, and rare outliers >100,000ha (Henderson 2005).

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 and bluebunch wheatgrass decrease, and short grasses (western wheatgrass, needle-and-thread grass, blue grama, 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 FRIs. 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 that 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 of this model (Rhodes, Volk, and Adams) 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, personal communication) 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.

Issues or 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.

Native Uncharacteristic Conditions

Comments

For LANDFIRE National, the model for MZ20 was originally adapted from Rapid Assessment 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 (B.J. 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 MZ 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 LANDFIRE National reviewers for this model for MZ20 were Steve Barrett, Mary Manning (USFS), Steve VanFossen (NRCS), and Jon Siddoway (NRCS).

A LANDFIRE National reviewer felt that drought could occur more often (i.e., about every 5yrs) than it was modeled, but because most wanted to model it longer, it was left unchanged.

Succession Classes

Mapping Rules

Upper Layer Lifeform	Height (m)	Canopy Cover (%)									
		0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Herb	0-0.5	B	B	B	B	B	B	B	B	B	B
Herb	0.5-1.0	A	A	A	A	A	A	C	C	C	C
Herb	>1.0	A	A	A	A	A	A	C	C	C	C
Shrub	0-0.5	A	C	C	C	C	UN	UN	UN	UN	UN
Shrub	0.5-1.0	A	C	C	C	C	UN	UN	UN	UN	UN
Shrub	1.0-3.0	A	C	C	C	C	UN	UN	UN	UN	UN
Shrub	>3.0	A	C	C	C	C	UN	UN	UN	UN	UN
Tree	0-5	C	C	UN	UN	UN	UN	UN	UN	UN	UN
Tree	5-10	C	C	UN	UN	UN	UN	UN	UN	UN	UN
Tree	10-25	C	C	UN	UN	UN	UN	UN	UN	UN	UN
Tree	25-50	C	C	UN	UN	UN	UN	UN	UN	UN	UN
Tree	>50	C	C	UN	UN	UN	UN	UN	UN	UN	UN

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

Description

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PASM	<i>Pascopyrum smithii</i>	Western wheatgrass	Upper
NAVI4	<i>Nassella viridula</i>	Green needlegrass	Upper
HECO26	<i>Hesperostipa comata</i>	Needle and thread	Upper
BOGR2	<i>Bouteloua gracilis</i>	Blue grama	Lower

Description

Class A represents the intact historic plant community functioning under grazing and/or fire, dominated by taller, cool- and warm-season rhizomatous 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.

Shrub species could be present with ~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.

Mappers -- please note that the vegetation in this class can certainly be <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.

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.

Native grazing by large ungulates could have occurred, including bison grazing. It is likely heavy locally due to increased succulence of young grasses.

Native grazing by prairie dogs could also occur on a small portion of the landscape.

Insect/disease occurs very infrequently. 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.

Maximum Tree Size Class

no data

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
BOGR2	Bouteloua gracilis	Blue grama	Upper
POSE	Poa secunda	Sandberg bluegrass	Upper
ARFR	Arenaria franklinii	Franklin's sandwort	Upper
DYPA	Dyssodia papposa	Fetid marigold	Upper

Description

Class B is very short-stature vegetation resulting from prairie dog disturbance or repeated high-intensity herbivory or trampling (e.g., 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 fuels in this class are generally too sparse to carry fire.

Native grazing (bison, pronghorn, and prairie dog) can be locally heavy due to increased succulence of young grasses 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 vs. domestic grazed communities are very different.)

Prairie dog disease could push this class to A.

It is thought that this class should comprise ~5-8% of the landscape and no more than 10% (Dan Uresk, personal communication). 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 – i.e., maybe 5-8%.

Maximum Tree Size Class

no data

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
NAVI4	<i>Nassella viridula</i>	Green needlegrass	Upper
PASM	<i>Pascopyrum smithii</i>	Western wheatgrass	Upper
SYOC	<i>Symphoricarpos occidentalis</i>	Western snowberry	Low-Mid
ARTR2	<i>Artemisia tridentata</i>	Big sagebrush	Upper

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. We would only expect to see ~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 west side of MZ. Little bluestem will be coming in more east of Havre.

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Shrubs can be present at 20% cover, 0-0.5m. Grasses are still the dominant species, with patches of shrubs increasing in abundance under longer-term fire intervals. Common shrubs -- silver sagebrush, winterfat, fringe sagewort, rubber rabbitbrush. Less common would be skunkbush sumac, mostly on slopes and shallow soils.

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.

Insect/disease occurs very infrequently. 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.

Maximum Tree Size Class

no data

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Late1:CLS	15
Mid1:OPN	1	Mid1:OPN	999
Late1:CLS	16	Late1:CLS	999

Probabilistic Transitions

Disturbance Type	Disturbance occurs In	Moves vegetation to	Disturbance Probability	Return Interval (yrs)	Reset Age to New Class Start Age After Disturbance?	Years Since Last Disturbance
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Insects or Disease	Early1:ALL	Early1:ALL	0.0001	10000	No	0
Optional 2	Early1:ALL	Mid1:OPN	0.001	1000	Yes	0
Optional 1	Early1:ALL	Mid1:OPN	0.001	1000	Yes	0
Wind or Weather or Stress	Early1:ALL	Early1:ALL	0.03	33	No	0
Replacement Fire	Early1:ALL	Early1:ALL	0.1	10	Yes	0
Native Grazing	Early1:ALL	Early1:ALL	0.2	5	No	0
Insects or Disease	Mid1:OPN	Early1:ALL	0.01	100	Yes	0
Alternative Succession	Mid1:OPN	Early1:ALL	0.01	100	Yes	0
Optional 2	Mid1:OPN	Mid1:OPN	0.1	10	No	0
Native Grazing	Mid1:OPN	Mid1:OPN	0.1	10	No	0
Insects or Disease	Late1:CLS	Early1:ALL	0.0001	10000	Yes	0
Optional 1	Late1:CLS	Early1:ALL	0.01	100	Yes	0
Wind or Weather or Stress	Late1:CLS	Late1:CLS	0.03	33	No	0
Replacement Fire	Late1:CLS	Early1:ALL	0.0667	15	Yes	0
Native Grazing	Late1:CLS	Late1:CLS	0.1	10	No	0

Optional Disturbances

Optional 1: drought + native bison grazing + small fire portion

Optional 2: prairie dog grazing

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