

LANDFIRE Biophysical Setting Model

Biophysical Setting 3111410

Northwestern Great Plains Mixedgrass Prairie

☒ This BPS is lumped with: 1085, 1488

☐ This BPS is split into multiple models: This BpS is lumped with 1085 and 1488. 1085 may be grouped into 1141 considering that the shrub species that may grow west of the Missouri River in ND and SD (Wyoming big sagebrush, silver sagebrush, rabbitbrush, fringed sagewort, western snowberry, etc.) obtain less than five percent cover.

There is a lot of western snowberry today, but there should not have been historically. In the mixedgrass prairie, uplands are now covered with snowberry, which probably did not exist historically. Mesic shrubs (snowberry, chokecherry, buffaloberry, etc.) occurred historically, but maybe more as inclusions within the mixedgrass prairie on more mesic sites (swales, draws, drainageways, north aspect slopes, etc.). It appears they are increasing on the landscape in absence of fire, migrating/expanding from their historic locations into adjacent uplands, especially snowberry. As combined with 1141 mixedgrass prairie, if there are more than 10% cover at over five percent of the landscape, it is probably uncharacteristic (Jeff DiBenedetto, USFS, pers comm.).

Don't map 1488. In western portion of MZs 31, 39 and 40, put 1488 occurrences into mixedgrass systems that are adjacent to it: 1132 or 1141.

General Information

Contributors (also see the Comments field)

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Vegetation Type

Upland
Grassland/Herbaceous

Dominant Species

PSSP6
NAVI4

Map Zone

31

Model Zone

☐ Alaska
☐ California

☒ Northern Plains
☐ N-Cent. Rockies

General Model Sources

- ☒ Literature
☐ Local Data
☒ Expert Estimate

PASM
HECOC8
SCSC
KOMA
ANGE
BOGR2

- ☐
☐ Great Basin
☐ Great Lakes
☐ Hawaii
☐ Northeast

- ☐
☐ Pacific Northwest
☐ South Central
☐ Southeast
☐ S. Appalachians
☐ Southwest

Geographic Range

This system covers northern NE into southern Canada, and through the Dakotas between the northern tallgrass prairie and the Rockies (Samson and Knopf 1998).

This system extends from northern NE into southern Canada, and west to central MT. The US range

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corresponds to Bailey et al. (1994) sections 331D, 331E, 331F (mostly), 331G, 332A, 332B, and perhaps minor extensions into 251B, and in Canada to the Moist Mixed Grassland and Fescue Grassland (NatureServe 2007).

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).

This system occurs in the western portion of MZs 39 and 40 and the north & northwest portions of MZ31.

Mixedgrass prairie is the dominant vegetation type in the Northern Great Plains Steppe Ecoregion.

Biophysical Site Description

The 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.

Mean annual precipitation is generally 10-25in, with the higher precipitation falling in the eastern portions especially adjacent to the northern tallgrass prairie areas. In northern areas such as ND that receive significant snowfall, snowmelt provides significant amounts of moisture to the landscape (i.e. many of the pothole wetlands embedded in the landscape are wet in the spring because of this snow melt). 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. (Although as it transitions to the warm season plants, BpS 1132 should be considered.)

This system 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.

The landscape is undulating rolling, and as you move west to east it becomes more level as you reach the Red River Valley and northern tallgrass prairie area.

Vegetation Description

According to Samson et al (1998), the mixedgrass prairie in the Drift Prairie Region in North and South Dakota is a wheatgrass-blue stem-needlegrass complex, while the Missouri Coteau region in these two states is known as the wheatgrass-blue grama-buffalo grass mixture.

The number of plant species found in the mixedgrass prairies exceeds that in other prairie types because of ecotonal mixing between the tallgrass and mixedgrass regions (Samson et al 1998).

This system contains >50% cover of natural, cool-season grasses such as *Festuca* spp., *Pascopyrum smithii*, *Elymus lanceolatus*, *Hesperostipa comata*, *Hesperostipa curtipetala* and *Nassella viridula* (NatureServe 2007).

The vegetation is dominated by cool and warm season perennial grasses including needle grasses (i.e. green needle, porcupine, needle and thread, etc) and wheatgrasses (i.e. western wheatgrass, slender wheatgrass, bearded wheatgrass). This northern mixedgrass area is typified by more C3 plants than the more southern regions of the mixedgrass (BpS 1132). Further east nearing the tallgrass prairie, warm season grasses such as big blue stem, little blue stem, side-oats grama, etc are more prevalent. *Hesperostipa spartea* could also be a dominant or indicator.

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The timing of precipitation and precipitation flushes that occur in mid-June through mid-July, going from west to east geographically, result in warm season grasses that are more prominent versus cool season grasses as transitioning to east, through the precipitation gradient. As one goes further east and north, MT and ND have a more typical ustic moisture regime, frigid temperature regimes. As one proceeds further west, it is more aridic ustic frigid. SD is more typical ustic and it gets mesic as one goes further south (WY, south SD) due to latitudinal gradients and elevational changes.

Shrubs and halfshrubs (Wyoming big sagebrush, silver sagebrush, rabbitbrush, fringed sagewort, western snowberry, etc.) obtain less than five percent cover. Most of the ground surface is covered and bare ground is less than 10% on more mesic sites and 20% on more xeric sites (e.g. glacial till, clay and soils).

The most common shrub is silver sagebrush and resprouts after fire. However, currently, with the absence of fire and occasional overgrazing, silver sagebrush has, locally, invaded upland sites and increased.

A diverse array of perennial summer forbs (black samson, scurfpea, prairieclovers, flax, dotted gayfeather, scarlet globemallow, etc.) occupies 10% of the community.

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

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.

Disturbance varied widely in size. Fires ranged from local (tens of acres) to landscape level (thousands of acres). Most fires were stand replacement in nature. Once ignited, dormant season fires would have spread over a large area until reaching a major firebreak (e.g. previously burned area, major river, rugged terrain, etc.) or a weather event (precipitation, wind direction change, humidity change, etc.). Growing season (mid-May to mid-Aug) fires may have been frequent but smaller in size than dormant season fires due to the greenness of the fuel and rain following lightning ignition. Growing season fires during drought years would have been much like dormant season fires. Mosaic fires were probably a result of patchy disturbed areas, topography, geography, hydrology and climate.

Fire and grazing were the dominant disturbances in this type. With estimates of 30-60 million bison in the Northern Great Plains (Isenberg 2000), herbivory by large mammals was also a significant disturbance to the grasslands. Large mammals preferentially grazed recently burned sites.

Bison were not the only major ungulate on the plains. Referencing Lewis and Clark journals, they observed large numbers of elk and antelope as well. The grazing patterns of these animals probably also influenced the frequency, extent and pattern of fire on the great plains. Reducing fuels where they grazed and affecting fire spread etc. These areas of grazing influence probably shifted seasonally and annually as a function of herd migration patterns.

Fire and grazing disturbances would have similar effects in temporary and seasonal wetlands, as well as in the wet meadow zone of the semi-permanent wetlands. Pondered wetlands would add to the patchy/mosaic

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nature of the fire effects over the landscape. Pothole hydrology is highly influenced by annual and long term climatic gradients - wet and drought cycles have persisted through history.

Fuel load recovery times are an alternative means by which to estimate the minimum average return interval for grassland fires, though this approach has not been formally attempted. A general decrease in productivity of ungrazed northern mixedgrass prairie is reported for 1-3yrs post-burn, and litter loads may take 11-16yrs to completely recover (as per various studies) (Henderson 2005). The total standing crop of fuel, combining both current year production and litter, is capable of recovering to pre-burn conditions in 4-8yrs (Shay et al. 2001). Theoretically, for repeated fires to occur without altering long-term grassland productivity and species composition, the mean return interval should be eight years or greater (Henderson 2005).

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. Fire-scarred tree-rings from areas within and adjacent to the northern Great Plains provide intervals within the 0-35yrs range over the past 500yrs (Henderson 2005). Given a minimum return interval of 0.5yrs, mode of eight years, and 95% probability of a fire occurring within 35yrs, the resulting right-skewed distribution makes possible return intervals >35yrs but probably never longer than 100yrs (Henderson 2005).

A negative exponential distribution probably best describes the historic fire size distribution, with a large number <1ha, median 10 to 100 ha, mean 1000-10,000ha and a low frequency of 50,000-1,000,000ha (Henderson 2005).

This area is strongly influenced by wet-dry cycles. Fire, grazing by large ungulates and small mammals such as prairie dogs, and soil disturbances (i.e. buffalo wallows and prairie dog towns) are the major disturbances in this vegetation type. Areas that receive more precipitation are more likely to have tallgrass return. During dry conditions, there would be more grazing near permanent sources of water. During favorable conditions, grazers would graze further from permanent water sources.

Grazing and prairie dog towns also reduced fuel loads, 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.

The prairie dog towns would have shifted slightly over long periods of time – becoming more flammable when the dogs move away (or periodically decrease). At their largest expansion periods, prairie dogs would have occupied up to 80% of their potential habitat. So, this would have had, periodically, a huge effect on ungulate grazing, fire and, probably, soil hydrology changes as they change with litter and dominant species (Mary Lata, USFS, pers comm).

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. (Buildups of litter generally result in decreased diversity and lower basal area of remaining grass plants.) 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 (Jon Siddoway, NRCS, pers comm).

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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. Drought periodicities centering around 58yrs were characteristic of SE Montana and eastern Wyoming for the last ~300yrs. A 22yr rhythm was characteristic of 1892-1977, but less clear for 1801-1889 and did not occur 1714-1801. Ten or more years without drought in any of the four areas occurred once or twice per century (Stockton and Meko 1983). In a Northern Great Plains HRV draft study by Judy von Ahlefeldt states that the frequency of droughts was > five years in length for 2-300yrs (Weakley 1943).

There would be a difference between BpS 1141 Northwestern Great Plains Mixedgrass Prairie and BpS 1132 Central Mixedgrass Prairie in terms of species response/plant functional group response (cool vs warm season) to grazing. Warm season grasses are decreasers during grazing, but the same species in the Northern version are increasers – i.e.: little bluestem. The cool season grasses/groups are better forage for grazers in the north with burning, because they are increasing. The cool season grasses initiate growth first. These are differences at a very small scale though. Overall, the intervals for BpS 1141 and 1132 are probably very similar.

Adjacency or Identification Concerns

Northwestern Mixedgrass Prairie BpS 1141 transitions into BpS 1132 Central Mixedgrass Prairie, which transitions to Tallgrass Prairie.

It is probably going to be difficult to distinguish Central Mixedgrass Prairie BpS 1132 from Northwestern Great Plains Mixedgrass Prairie BpS 1141. The distinction can probably be done based on soils and geography. See Geographical sections in both models for information too. Central Mixedgrass 1132 adheres to the Central and Southern Great Plains, whereas Northwestern Great Plains Mixedgrass 1141 adheres to Northern Great Plains. BpS 1141 probably excludes the sandhills and goes from northern Nebraska and west to central Montana and is bordered on the east by Central Mixedgrass 1132. BpS 1141 Northwestern version is probably defined by the Missouri River. See Geographical description for more information. However, BpS 1141 should transition to BpS 1132 which should transition to tallgrass prairie systems. The boundaries of this system are defined by soils and topography, and this system tends to transition gradually into other systems. Precipitation zone is another indicator, as there seems to be an east – west change in precipitation going from low (west) to higher (east).

The distinction between BpS 1132 and 1141 might also be based on the shift between cool and warm season grasses. The difference between BpS 1132 and 1141 is the C3-C4 shift of cool to warm season grass species. In BpS 1141, there are more western – festucas, needle and thread, stronger cool season component than BpS 1132.

The central mixedgrass prairie is not well defined but in general is a transition area between the tallgrass prairie and mixedgrass prairie. There is higher precipitation and taller grasses than in 1141. There are more shrubby species. 1141 is further west and has ARTR2, whereas 1132 has more chokecherry/sumac.

Main difference is 1132 has higher moisture regime, more tallgrass plants, and lack of fire results in more shrubs and trees. Productivity might be lower in 1141 - soils generally not quite as deep, less rain, probably less litter build up as well, although the higher moisture in 1132 would allow litter to decompose at a faster rate (Mary Lata, USFS, pers comm).

BpS 1141 wouldn't function differently than 1132, and it wouldn't key out differently (Steve Cooper, pers

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comm). The only way you might be able to tell this apart is by geography. 1141 is further west.

Estimated declines in the mixedgrass prairie range from 68.3% in ND and 70% in SD (Samson et al. 1998). However, there are some good examples of mixedgrass prairie still in the Dakotas. There are some well managed ranches and parks. There is enough public land – approximately three million acres of national grasslands as well as national parks which are in good condition. There are also some private lands in good condition. There are some shifts in species but perhaps just western wheatgrass and blue grama (Jack Butler, USFS, pers comm).

Portions of the northwestern mixedgrass prairie have been converted to agricultural production, urbanized, or have been overgrazed by domestic grazers. In the more eastern portions of this area, the landscape is cropland-dominated with remnant grasslands occurring in patchy islands throughout (i.e. the Drift Prairie). The more western portions of the system often lack management regimes that sustained the wetland in pristine times.

Prairie remnants are heavily invaded with woody vegetation and invasive species such as smooth brome in some areas, Kentucky bluegrass in small areas, and noxious weeds such as Canada thistle, leafy spurge, plumeless thistle, bull thistle, etc. Wetlands are often dominated by monotypic stands of reed canary grass or narrow-leaf and/or hybrid cattail. 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.

Grassland areas that are heavily invaded with smooth brome or Kentucky bluegrass may appear similar to native sod areas simply because of grass presence, regardless of species composition or structure. Crested wheatgrass is also a non-native grass which has been seeded extensively in the plains.

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 such as blue grama and sandberg bluegrass increase, and western wheatgrass and needle and thread grass act as midgrass decreasors. Also under this grazing regime, litter may increase (depending on precipitation and intensity of grazing) with the expected results of decreased diversity and decreased vigor of remaining grasses. 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.

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 midgrass dominated community to shortgrass dominated communities (blue grama, sedges, and sandberg bluegrass, buffalograss in southern portions, junegrass). This should be distinguished from the s-class (class B) that's influenced more by presence of prairie dog towns - which have a higher forb component with less of a midgrass component than the other classes. In

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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.

The expansion of ponderosa pine and shrubs, including snowberry, yucca and prickly pear is noticeable, but more so (at least for these species) in the eastern portion of MZs 29 and 30 and into MZs 39 and 40. There is also an increase of snowberry in draws, swales and upland depressions and expansion to adjacent upland settings.

Shrubs such as sagebrush and other shrubs (Wyoming sagebrush, silver sagebrush, western snowberry, rabbitbrush and fringed sagewort) increase greatly over the historic plant community. Silver sagebrush being a sprouter probably did occupy sites historically and now might have increased in density, but not aerial extent. It is however a shrub dominant on river and stream terraces (wooded draw and ravine BpS or floodplains BpS), where its seen today. Wyoming big sagebrush, where it occurs on the plains, is generally widely spaced, low density stands which probably functioned similarly to big sagebrush to the west.

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 (shrubs might include *Opuntia* spp and *Yucca* spp in NE). Xeric sites will experience an increase in sagebrush, whereas western snowberry will increase in mesic areas.

With the absence of fire and occasional overgrazing, silver sagebrush has, locally, invaded upland sites - at least that's how the range people interpret it. It's questionable as to how extensive silver sagebrush was historically; however the fact that sage grouse were historically collected all the way east to the Missouri River causes question about the previous extent of sagebrush (Dave Ode, pers comm.).

There might be places, as there are further south and east of MZs 29 and 30, that now have crested wheatgrass as a major component, as it was heavily seeded in the 1930s (Mary Lata, USFS, pers comm). Major seeding of crested wheatgrass occurred up through the 1950's with sporadic seeding occurring recently, particularly on CRP lands.

There is more woody species invasion further east. At 20in precipitation, deciduous trees invade from the draws. If the area is not burned, it will lose the prairie. In eastern ND and SD, there are trees that if left unburned would engulf the prairie systems (but that's the tallgrass prairie, which is almost all agriculture now. Much of the mixedgrass prairie is converted to agriculture today). That wouldn't occur in the west as much. Trees would be restricted to the microclimate situation or in draws (Brian Martin, TNC, pers comm).

When thinking about similarity or departure from historic or uncharacteristic communities at landscape levels, the following situations might be useful to check mapping results against classification and model logic. The major influences on current vegetation composition and structure in the Great Plains are (Jeff diBenedetto, USFS, pers comm):

1) Conversion of grassland/shrublands to cropland (uncharacteristic types).

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2) Introduced species, primarily crested wheatgrass, annual bromes, smooth brome etc. and yellow sweetclover (uncharacteristic type).

3) Shift from midgrass dominated grassland communities to shortgrass dominated communities through season long heavy grazing (departure from historic, if percentage is outside range of variability. Prairie dog towns would fit into this category. This dynamic can be a response to longterm periodic drought as well (departure from historic range). The midgrass to shortgrass change is a shift that has occurred historically in response to fluctuating climate (drought, above normal precipitation cycles), grazing intensity/recovery. More may be in shortgrass, under current intensive pastoral grazing systems vs. migratory grazing patterns that occurred historically. Grazing would shift midgrass communities to shortgrass dominated communities (Bison may or may not have influenced this, but season long heavy livestock grazing seems to cause this shift). So a high percentage of the landscape in shortgrass, vs midgrass would indicate a departure.

4) Shift from grassland communities to forest, wooded, or shrub dominated communities in absence of fire (departure or uncharacteristic for grass BpS). This may be a key shift that has occurred or is occurring on the Great Plains along with conversion of rangeland to cropland and planting of exotic grass species (CRP lands). This is probably more meaningful in terms of fire disturbance relationships than the shortgrass-midgrass shift.

With the exception of areas occupied by prairie dog towns, the characteristic late successional communities should be dominated by midgrass dominated plant communities. Tall grass dominated communities would only occur as unmapped inclusions associated with topo-edaphic positions. Tall grass dominated communities include those dominated by prairie sandreed, big bluestem and prairie cordgrass.

Native Uncharacteristic Conditions

With lack of fire, increased shrub or tree cover would be uncharacteristic, and is present west of the Missouri River in ND and SD.

Scale Description

Disturbance varied widely in size. Fires ranged from local (tens of acres) to landscape level (thousands of acres). Most fires were stand replacement in nature. Once ignited, dormant season fires would have spread over a large area until reaching a major firebreak (e.g. previously burned area, major river, rugged terrain, etc.) or a weather event (precipitation, wind direction change, humidity change, etc.). Growing season (mid May to mid Aug) fires may have been frequent but smaller in size than dormant season fires due to the greenness of the fuel and rain following lightning ignition. Growing season fires during drought years would have been much like dormant season fires. Mosaic fires were probably a result of patchy disturbed areas, topography, geography, hydrology and climate.

Bison herbivory occurred in a mob grazing or flash grazing method, with extensive herds migrating across the prairie as they graze.

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 from bison, elk, antelope and other ungulates. The grazing patterns of these animals probably also influenced the frequency, extent and pattern of fire on the Great Plains. Reducing fuels where they grazed and affecting fire spread etc. These areas of grazing influence probably shifted

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seasonally and annually as a function of herd migration patterns.

A negative exponential distribution probably best describes the historic fire size distribution, with a large number <1ha, median 10-100ha, mean 1000-10,000ha, a low frequency of 50,000-1,000,000ha and rare outliers >1,000,000ha (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.

Again, it needs to be emphasized that the original MZs 31, 39 and 40 modelers were most proficient with the mixedgrass portions that are west of the Missouri River in ND and SD. They were recording from a knowledge base of the Drift Prairie and Missouri Coteau regions of ND and SD, which encompasses the transition zone from tallgrass to mixedgrass prairie as defined by Samson et al (1998). Therefore the results here were a best professional judgment based on our experiences working in ND, SD, and MN.

Comments

This model for MZs 31, 39 and 40 was originally adapted by Cami Dixon, Sara Vacek and Shane DelGrosso from the draft model for BpS 1420 Northern Tallgrass Prairie from MZs 39 and 40 created by Cami Dixon, Sara Vacek, Shane DelGrosso, Sandy Smart and Kyle Kelsey with little quantitative changes made. However, based on expert review for MZs 31, 39 and 40, the model was then changed by co-RL for all three zones, to more similarly mimic BpS 1141 in MZs 29 and 30, which was intended to cover eastward as well, and to more similarly mimic BpS 1132 created by Morgan Beveridge, Paul Pooler and Mark Browning, the other mixedgrass model in MZs 31, 39 and 40, instead of having this model for 1141 mimic tallgrass prairie.

BpS 1420 Adaption/Evolution: The model for BpS 1420 for MZs 39 and 40 was adapted from the Rapid Assessment (RA) model: R4PRTGn Northern Tallgrass Prairie created by Jim Drake jim_drake@naturereserve.org and Jim Decoster jim_decoster@nps.gov and reviewed by Daryl Smith daryl.smith@uni.edu.

BpS 1141 Adaption/Evolution: BpS 1141 model for MZs 29, 20 and 30 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. Subsequent to s-class review for MZ20, model for MZs 29 and 30 was changed based on mapping constraints to a two-box model. Therefore, model for MZs 29 and 30, is different than that for MZ20 in sclass proportions, age ranges, and cover/height and boxes. Other reviewers for MZs 29 and 30 were Shannon Downey, Jeff Jones, Steve Cooper and Mary Lata.

Other reviewers for BpS 1141 model for MZ20 were Steve Barrett, Mary Manning (USDA Forest

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Service), Steve VanFossen (NRCS) and Jon Siddoway (NRCS).

1132 Adaption/Evolution: This model for MZs 31 and 39 was adapted from the model from the same BpS from MZ30 created by Mitch Iverson, Amy Symstad and Travis Lipp and reviewed by Steve Cooper, Steve VanFossen and Eldon Rash. Model for MZs 31 and 39 changed significantly quantitatively. Co-RL for MZs 31 and 39 also made some model tweaks to more similarly match MZ30 model. Review also resulted in quantitative changes, but modelers were consulted to determine if they wanted to change modelership or not.

The model for BpS 1132 for MZs 29 and 30 was adapted from the RA model R4PRMGn Northern Mixed Grass Prairie, created by Cody Wienk and Lakhdar Benkobi and reviewed by David Engle and John Ortmann. Other modeler for MZ30 was Terry Chaplin. Other reviewer was Jim Von Loh. RL for MZ30 also provided input and changes to the model to a great extent. Approval from original modelers/reviewers sought.

Vegetation Classes

Class A 25 %

Early Development 1 Open

Upper Layer Lifeform

- ☒ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

1

Indicator Species and Canopy Position

Upper
BOGR2
Upper
PASM
Upper
HECO26
Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	40 %
Height	Herb 0m	Herb 1.0m
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

This represents the post-disturbance or post-fire stage community functioning under grazing and/or fire, dominated by cool and warm season rhizomatous perennial grasses, as well as bunchgrasses.

Dominant species are those common to the Northern Mixed Grass Prairie: *Hesperostipa comata*, *Nasella viridula*, *Andropogon gerardii*, *Bouteloua gracilis*, *Koeleria macrantha*, *Pascopyrum smithii*, *Buchloe dactyloides* and maybe *Hesperostipa spartea*. Other grasses are *Schizachyrium scoparium*, *Calamovilfa longifolia* and *Pseudoroegneria spicata* occur as dominant species in small patches. Other species in this class are *Artemisia* and western yarrow.

Due to the combination of the prairie dog stage (indicator species: BOGR2, POSE, ARFR and DYPA) and the early successional stage (indicator species: PASM, NAV14, HECO26 and BOGR2), the indicator species were combined for this class.

Forbs such as *galium boreale* are more abundant in the immediate post-fire vegetation. A variety of forb species such as scarlet globemallow and curlycup gumweed could also be common in this class. This class will have species that are grazing resistant and low growing and drought-tolerant.

Fringed sagebrush can also be a component of this class. Prickly pear, man sage (ARLU) and broom snakeweed occur in this class. Abundance of prickly pear is much higher than in other seral stages.

**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 might be a shortgrass EVT. A higher proportion of this class on the landscape today would indicate departure.

The fuel in this class is generally too sparse and/or too short to carry fire.

This class lasts approximately three or more years. If in a prairie dog state, then the class would last longer in order to transition out of it; however, this is accounted for, by having a prairie dog disturbance in the model, resetting succession and keeping it in this class. The three-year interval attempts to capture what would happen post-fire or post-drought. (Also - post-heavy-grazing in current conditions would take longer to transition out of this class.)

The prairie dog stage would increase in size during drought and grazing and then it would decrease during a wet cycle. It's a shifting mosaic of prairie dog movement and towns dependent on grazing and wet/dry cycles. Prairie dogs probably occupied between 15-40% of an area during some time. Class A should probably have between this amount, since class A includes both the prairie dogs and post-disturbance areas. Amount in this class would also vary by distance to permanent sources of water. However, another camp feels that a prairie dog class should comprise approximately 5-8% of the landscape, and no more than 10% (Dan Uresk, pers comm). Research for historical NGP 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%.

Data from prairie dog towns (early seral, aka class A) suggest cover ranges from 0-80%. Height is the most valuable measure of difference between early and other seral stages, but height in mixedgrass prairie often is not much greater than 50cm -- resolution of mapping may not be great enough to distinguish among classes.

High, prolonged heavy grazing was modeled as Optional 1. This occurs on 20% of this class each year, keeping it in this class. This includes prairie dog impact.

Drought combined with grazing was modeled as Optional 2. This occurs on 1.2% (0.012 probability - every 80yrs) of this class each year. Drought alone was modeled as wind/weather stress occurring every 25yrs but not setting it back to the beginning of the stage.

Regular grazing occurs on 60% of class each year.

Most of this class A couldn't carry a fire if heavy grazing and drought are occurring as well as prairie dogs. Therefore, replacement fire was modeled to occur every 25yrs. Fire also doesn't set this stage all the way back to the beginning, considering the grasses would quickly resprout. It would take fire, grazing, drought to set it all the way back to the beginning (not technically modeled). Drought conditions could force this stage back to bare ground and annuals. Historically, however, there was very little of the component of annuals and shrubs.

Because of Landfire mapping rules, canopy cover is arbitrary number. These classes should actually be defined on the ground by biomass, litter, species.

Very little of A, B remain on the landscape today; most is C.

****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 70 %

Mid Development 1 Open

Upper Layer Lifeform☒ Herbaceous☐ Shrub☐ Tree**Fuel Model**

3

Description**Indicator Species and Canopy Position**

PASM

Upper

NAVI4

Upper

HESP11

Upper

BOGR2

Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	100 %
Height	Herb 0m	Herb 1.0m
Tree Size Class		

☐ 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 B 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. This is the all-encompassing mid-late-development, functioning fine stage.

Mixedgrasses and forbs are dominant, woody vegetation (shrubs and trees) are widely scattered and limited to micro sites that escaped fire or to mature fire resistant trees. Both of these occur more commonly in the eastern parts of this Type.

Common species are Hesperostipa comata, Nasella viridula, Andropogon gerardii, Bouteloua gracilis spartea and Hesperostipa spartea. Schizachyrium scoparium, Calamovilfa longifolia and Pseudoroegneria spicata occur as dominant species in small patches. Other species in this class are Artemisia, grama grasses, western yarrow and prairie junegrass.

Forbs such as galium boreale are more abundant in the immediate post-fire vegetation.

Because of Landfire mapping rules, canopy cover is arbitrary number. These classes should actually be defined on the ground by biomass, litter, species. This class can be distinguished from A based on Fuel model (3 for B vs 1 for A) and biomass.

Replacement fire occurs every 10-15yrs. Replacement fire was modeled as occurring every 10yrs, most of the time not causing a transition back to the beginning, but some of the time causing a transition back to A. After fire, there is probably also heavy grazing. 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.

Native grazing occurs on approximately 20% of the class each year, maintaining this stage. High, prolonged heavy grazing was modeled as Optional 1, including prairie dogs. This occurs on approximately 25% of this class each year.

Drought can also occur, but infrequently causing a transition back to class A. Regular drought could occur and not cause a transition (not modeled).

The combination of drought and grazing (option 2) occurs infrequently bringing this class back to A.

**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.

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.

With lack of fire, encroachment might occur after this class. Trees (juniper, chokecherry) and shrubs might appear with higher cover. This class was therefore modeled as succeeding within itself but having an alternate successional pathway going to C with a probability of 0.01.

It would be uncharacteristic to have higher than 20% cover of shrubs/trees. Shrub species could be present at 0-10% cover. Silver sagebrush and winterfat (on deeper soils) are the most common shrub, and would start resprouting. WY big sagebrush can also be a component (on shallower soils) of this BpS, although a small component.

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.

Class C	5 %	<u>Indicator Species and Canopy Position</u>	<u>Structure Data (for upper layer lifeform)</u>												
Late Development 1 Closed		PRVI	<table><tr><td></td><td><i>Min</i></td><td><i>Max</i></td></tr><tr><td><i>Cover</i></td><td>0 %</td><td>60 %</td></tr><tr><td><i>Height</i></td><td>Shrub 0m</td><td>Shrub >3.1m</td></tr><tr><td><i>Tree Size Class</i></td><td colspan="2"></td></tr></table>		<i>Min</i>	<i>Max</i>	<i>Cover</i>	0 %	60 %	<i>Height</i>	Shrub 0m	Shrub >3.1m	<i>Tree Size Class</i>		
	<i>Min</i>	<i>Max</i>													
<i>Cover</i>	0 %	60 %													
<i>Height</i>	Shrub 0m	Shrub >3.1m													
<i>Tree Size Class</i>															
<u>Upper Layer Lifeform</u>		Upper SYOC													
☐ Herbaceous		Upper JUVI	☐ Upper layer lifeform differs from dominant lifeform.												
☒ Shrub		Upper PASM													
☐ Tree		Mid-Upper													
	<u>Fuel Model</u>														
	3														
<u>Description</u>			Grasses encompassed open areas between stands of cedar. The grasses are still dominant, but shrub species are becoming more prominent on the landscape.												

The transition to class C would occur due to lack of fire over an extended period of time. This shrubby stage might occur more on the eastern end of the mapzones. Other species might include silverberry, quaking aspen (*Populus tremuloides*), willow (*Salix* spp.), cottonwoods, box elder, snowberry and prunus and can form dense thickets.

Shrubs and other climax species would dominate with an understory of fine fuel within the unburned area. Any areas within this class that do burn would return to class A conditions.

Grazing occurs that would cause a transition back to B on two percent of the class each year.

Replacement fire occurs approximately every 10yrs.

**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]

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

Class E 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

Disturbances

Fire Regime Group:** II

Historical Fire Size (acres)

Avg
Min
Max

Sources of Fire Regime Data

- ☒ Literature
☐ Local Data
☒ Expert Estimate

Additional Disturbances Modeled

- ☐ Insects/Disease ☒ Native Grazing ☒ Other (optional 1) heavy prolonged grazing including prairie dogs
☒ Wind/Weather/Stress ☐ Competition ☒ Other (optional 2) drought with grazing

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	8	2	40	0.125	100
Mixed					
Surface					
All Fires	8			0.12502	

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.

References

Anderson, R.C. 1990. The historic role of fire in the North American grassland. Pages 8-18 in S.L. Collins and L.L. Wallace, editors. Fire in North American tallgrass prairies. University of Oklahoma Press, Norman, OK.

**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.

- Benkobi, L. and D.W. Uresk. 1996. Seral Stage Classification and Monitoring Model for Big Sagebrush/Western Wheatgrass/Blue Grama Habitat. In: Barrow, Jerry R.; McArthur, E. Durant; Sosebee, Ronald E.; Tausch, Robin J., (compa.). Proceedings: shrubland ecosystem dynamics in a changing environment; 1996 May 23-25; Las Cruces, NM. Gen. Tech. Rep. INT-GTR-338. Ogden, UT: USDA Forest Service, Intermountain Research Station.
- Bragg, T.B. and A.A. Steuter. 1995. Mixed prairie of the North American Great Plains. Trans. 60th No. Am. Wild. & Natur. Resour. Conf. pp. 335-348.
- Collins, S.L. and L.L. Wallace (editors). 1990. Fire in North American tallgrass prairies. University of Oklahoma Press, Norman, OK.
- Dahl, T.E. 1990. Wetland losses in the U.S. 1780's-1980's. U.S. Dept Interior FWS. Washington DC, 13 pp.
- Henderson, Darcy C. 2005. Fire Regime for the Grasslands National Park Fire Management Plan, Second Draft, September 8, 2005.
- Higgins, K.F. 1984. Lightning fires in North Dakota grasslands and in pine-savanna lands of South Dakota and Montana. *Journal of Range Management* 37(2): 100-103.
- Higgins, K.F. 1986. Interpretation and compendium of historical fire accounts in the Northern Great Plains. USDI Fish and Wildlife Service Resource Publication 161, Washington, D.C., USA.
- Isenberg, A.C. 2000. *The Destruction of the Bison: An Environmental History, 1750-1920*. Cambridge Univ. Press, New York, NY.
- Knight, D.H. 1994. *Mountains and Plains, The Ecology of Wyoming Landscapes*. Yale University Press, New Haven, CT.
- NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 15 April 2007.
- Samson, F.B., F.L. Knopf and W.R. Ostlie. 1998. Grasslands. Pages 437-472 in M.J. Mac, P.A. Opler, C.E. Puckett Haecker, and P.D. Doran, eds. *Status and Trends of the Nation's Biological Resources*, Vol. 2. Jamestown, ND.
- Shay, J, Kunec, D and Dyck, B. 2001. Short-term effects of fire frequency on vegetation composition and biomass in mixed prairie in south-western Manitoba. *Plant Ecology*. 155: 157-167.
- Singh, J.S., W.K. Lauenroth, R.K. Heitschmidt and J.L. Dodd. 1983. Structural and functional attributes of the vegetation of northern mixed prairie of North America. *The Botanical Review* 49(1):117-149.
- Stockton, C.W. and Meko, D.M. 1983. Drought recurrence in the Great Plains as reconstructed from long-term tree ring records. *Journal of Climate and Applied Meteorology*. 22:17-29.
- USDA-NRCS. 2003. eFOTG: Electronic Field Office Technical Guide. Available at: <http://www.nrcs.usda.gov/technical/efotg/>.

**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.

Weakley, H.E. 1943. A tree ring record of precipitation in western Nebraska. Journal of Forestry.

Weaver, J.E. and F.W. Albertson. 1956. Grasslands of the Great Plains: their nature and use. Johnsen Publishing Company, Lincoln, NE.

Woods, Omernik, Nesser, Shelder, Comstock, Azevedo. 2002. Ecoregions of Montana, 2nd edition.

Wright, H.A. and A.W. Bailey. 1980. Fire ecology and prescribed burning in the Great Plains—a research review. USDA Forest Service General Technical Report INT-77. Intermountain Forest and Range Experiment Station, Ogden, UT.

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