11410

Northwestern Great Plains Mixed-Grass Prairie

BpS Model/Description Version: Aug. 2020

Vegetation Type

Herbaceous

Map Zone

40

Model Splits or Lumps

This biophysical setting (BpS) is lumped with 1085 and 1488.

Geographic Range

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

This system extends from northern Nebraska into southern Canada, and west to central Montana. The U.S. range corresponds to sections stipulated by Bailey et al. (1994): 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 levels 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 map zones (MZs) 39 and 40, and the north and northwest portions of MZ31.

Mixed-grass prairie is the dominant vegetation type in the Northern Great Plains Steppe ecoregion.

Biophysical Site Description

The elevations range from 1,900-4,000ft, or up to 6,500ft 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 greater amount of precipitation falling in the eastern portions of the range, especially adjacent to the northern tallgrass prairie areas. In northern areas such as North Dakota, which 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 snowmelt). 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 mixed-grass prairie in the Drift Prairie Region in North and South Dakota is a wheatgrass-blue stem-needlegrass complex, whereas the Missouri Coteau region in these two states is known as the wheatgrass-blue grama-buffalograss mixture.

The number of plant species found in the mixed-grass prairies exceeds that in other prairie types because of ecotonal mixing between the tallgrass and mixed-grass 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 curtiseta*,and *Nassella viridula* (NatureServe 2007).

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

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 one transitions to east, through the precipitation gradient. As one goes farther east and north, Montana and North Dakota have a more typic, ustic moisture regime and frigid temperature regimes. As one proceeds farther west, more aridic, ustic frigid is seen. South Dakota is more typic ustic and it gets mesic as one goes farther south (Wyoming, southern South Dakota) due to latitudinal gradients and elevational changes.

Shrubs and half-shrubs (e.g., Wyoming big sagebrush, silver sagebrush, rabbitbrush, fringed sagewort, western snowberry) 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, clay, and soils).

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

A diverse array of perennial summer forbs (e.g., blacksamson, scurfpea, prairieclover, flax, dotted gayfeather, scarlet globemallow) occupies 10% of the community.

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 Adjacency or Identification Concerns, or Issues or Problems sections.

BpS Dominant and Indicator Species

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

Disturbance Description

Periodic grazing and replacement fire, when it occurred in an intact community, resulted in removal of most of the aboveground 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) or a weather event (e.g., precipitation, wind direction change, humidity change). Growing-season (mid-May through mid-August) 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 by reducing fuel where they grazed, affecting fire spread, and so on. 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. Pond wetlands would add to the patchy/mosaic 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, although this approach has not been formally attempted. A general decrease in productivity of ungrazed northern mixed-grass prairie is reported for 1-3yrs post-burn, and litter loads may take 11-16yrs to recover completely (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 8yrs or more (Henderson 2005).

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 FRI. Fire-scarred tree rings from areas within and adjacent to the northern Great Plains provide FRIs within the 0- to 35-yr range over the past 500yrs (Henderson 2005). Given a minimum FRI of 0.5yr, mode of 8yrs, and 95% probability of a fire occurring within 35yrs, the resulting right-skewed distribution makes possible FRIs >35yrs, but probably never longer than 100yrs (Henderson 2005).

A negative exponential distribution probably best describes the historical fire size distribution: with a large number, <1ha; median, 10-100ha; mean, 1,000-10,000ha; and low frequency, 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 farther from permanent water sources.

Grazing and prairie dog towns also reduced fuel loads, fire frequency, fire size, and fire intensity, with the most substantial impacts in valley bottom shrublands and grasslands, and upland grasslands near water. Historically, most human-caused ignitions were concentrated in spring and fall, whereas 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 moved away (or periodically decreased). 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 because 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 >14 in (snowberry and green ash) in precipitation zones and a buildup of dead grass. (Buildups of litter generally result in decreased diversity and lower basal area of remaining grass plants.) In 10- to 14-in 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 on this system than currently defined, but we are unsure of historical impact and frequency (Jon Siddoway, NRCS, pers. comm.).

Drought also occurs somewhat frequently. Some modelers felt it occurred every 30yrs; some believed it occurred every 5yrs. Short-term precipitation variability may also influence species productivity. Drought periodicities centering around 58yrs were characteristic of southeast Montana and eastern Wyoming for the past ~300yrs. A 22-yr rhythm was characteristic of 1892-1977, but was less clear for 1801-1889, and did not occur in 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 historical range of variability draft study, Judy von Ahlefeldt states that the frequency of drought was >5yrs for 2-300yrs (Weakley 1943).

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

Fire Frequency

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

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) or a weather event (precipitation, wind direction change, humidity change). Growing-season (mid May-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 grazed.

Historically, natural grazing and fire generally encompassed hundreds to hundreds of thousands of acres. Repeated heavy animal impact, such as prairie dog towns, occurred on a scale of tens to thousands of acres, as did 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, affecting fire spread, and so on. These areas of grazing influence probably shifted seasonally and annually as a function of herd migration patterns.

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

Adjacency or Identification Concerns

Northwestern Mixed-Grass Prairie BpS 1141 transitions to BpS 1132 Central Mixed-Grass Prairie, which transitions to tallgrass prairie.

It is probably going to be difficult to distinguish Central Mixed-Grass Prairie BpS 1132 from Northwestern Great Plains Mixed-Grass Prairie BpS 1141. The distinction can probably be done based on soils and geography. See “Geographic Range” sections in both models for information too. Central Mixed-Grass Prairie 1132 adheres to the Central and Southern Great Plains, whereas Northwestern Great Plains Mixed-Grass Prairie 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 Mixed-Grass 1132. BpS 1141 northwestern version is probably defined by the Missouri River. See “Geographic Range” 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 to other systems. Precipitation zone is another indicator; there seems to be an east-west change in precipitation going from low (west) to high (east).

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

The Central Mixed-Grass Prairie is not well defined; but, in general, it is a transition area between tallgrass prairie and mixed-grass prairie. There is greater precipitation and taller grasses than in 1141. There are more shrubby species. BpS 1141 is farther west and has ARTR2, whereas 1132 has more chokecherry/sumac.

The main difference is 1132 has a higher moisture regime, more tallgrass plants, and a lack of fire, which results in more shrubs and trees. Productivity might be lower in 1141. Soils are generally not quite as deep, there’s less rain, and there’s probably less litter build up as well, although the greater moisture levels in 1132 allow litter to decompose at a faster rate (Mary Lata, USFS, pers. comm.).

BpS 1141 would not function differently than 1132, and it would not key out differently (Steve Cooper, pers. comm.). The only way you might be able to tell them apart is by geography. 1141 is farther west.

Estimated declines in the mixed-grass prairie range from 68.3% in North Dakota and 70% in South Dakota (Samson et al. 1998). However, there are some good examples of mixed-grass prairie still in the Dakotas. There are some well-managed ranches and parks. There is enough public land -- approximately 3,000,000ac of national grasslands as well as national parks – that is 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 mixed-grass prairie have been converted to agricultural production or urbanization, 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, and more. Wetlands are often dominated by monotypic stands of reed canarygrass or narrowleaf and/or hybrid cattail. Other invasive species of concern include spotted, diffuse Russian knapweeds, often along roads and stream corridors; leafy spurge and Canadian thistle, along stream corridors; yellow sweetclover; Dalmatian toadflax; and annual bromes, including Japanese brome. Dense clubmoss stands are also a problem in this class, as is blue grama, which limit 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 that has been seeded extensively in the plains.

Areas with similar soils but steeper topography (>15%) are less productive and have a greater dominance of shrubs.

The natural grazing regime has been replaced with domestic livestock grazing 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 historical 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; 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 and sedges, Sandberg bluegrass and buffalograss in southern portions, and junegrass). This should be distinguished from the S-class (Class B), which is influenced more by the presence of prairie dog towns, which has a greater forb component with less of a midgrass 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 historical 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 historical plant community regimes. Because silver sagebrush is a sprouter, it probably did occupy sites historically and now might have increased in density, but not to an aerial extent. It is, however, a shrub dominant on river and stream terraces (Wooded Draw and Ravine BpS or Flooplains BpS), where its seen today. Wyoming sagebrush, where it occurs on the plains, generally occurs in widely spaced, low-density stands, which probably function similarly to big sagebrush in the west.

Compare the ecological site description to avoid using a shrub model for a historical 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 (shrubs might include *Opuntia* spp. and *Yucca* spp. in Nebraska). Xeric sites experience an increase in sagebrush, whereas western snowberry increases in mesic areas.

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

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

There is more woody species invasion farther east. At 20in of precipitation, deciduous trees come out and invade from the draws. If the area is not burned, it loses the prairie. In eastern North Dakota and South Dakota, there are trees there that, if they do not burn, will cover up the prairie systems, but that is the tallgrass prairie, which is almost all agriculture now. Much of the mixed-grass prairie is converted to agriculture today. This does not occur in the west as much. Trees are restricted to the microclimate situation or are in draws (Brian Martin, TNC, pers. comm.).

When thinking about similarity or departure from historical 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 as follows (Jeff diBenedetto, USFS, pers. comm.):

1. Conversion of grassland/shrublands to cropland (uncharacteristic types)
2. Introduction of introduced species, primarily crested wheatgrass, annual bromes, smooth brome, and so on, and yellow sweetclover (uncharacteristic type)
3. Shift from midgrass-dominated grassland communities to shortgrass-dominated communities through season-long heavy grazing (departure from historical, if percentage is outside range of variability). Prairie dog towns fit into this category. This dynamic can be a response to long-term periodic drought as well (departure from historical range). The midgrass to shortgrass change is a shift that has occurred historically in response to fluctuating climate (drought, above-normal precipitation cycles) and grazing intensity and recovery. More may be in shortgrass, under current intensive pastoral grazing systems versus the migratory grazing patterns that occurred historically. Grazing shifts 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 versus midgrass indicates a departure.
4. Shift from grassland communities to forest, wooded, or shrub-dominated communities in absence of fire (departure or uncharacteristic for grass BpSs). 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.

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

Issues or Problems

This BpS covers a large, diverse area, with relatively little extensive data or published studies for vegetation classification. Fire frequency is estimated primarily on inference based on understanding of the plant community dynamics and anecdotes or historical research (mostly oral histories) regarding Native American burning.

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

Native Uncharacteristic Conditions

With lack of fire, increased shrub or tree cover is uncharacteristic and is present west of the Missouri River in North and South Dakota.

Comments

In this model, Other 1 includes grazing and prairie dog impact. Drought combined with grazing is modeled as Other 2, and drought alone is modeled as wind/weather/stress.

For LANDFIRE National, 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 few 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 mimic more closely BpS 1141 in MZs 29 and 30, which was intended to extend farther east as well, and to mimic more closely BpS 1132 (was created by Morgan Beveridge, Paul Pooler, and Mark Browning), the other mixed-grass model in MZs 31, 39 and 40, instead of having this model for 1141 mimic tallgrass prairie.

*BpS 1141 Adaption/Evolution*: The 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 (B. J. Rhodes, John Carlson, Rich Adams, and Bill Volk) suggested changes and altered this model to a three-box model. Agreement and input were 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 the 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 that were 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 s-class proportions, age ranges, 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 (USFS), Steve VanFossen (NRCS), and Jon Siddoway (NRCS).

Succession Classes

**Mapping Rules**

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**

Class A 25 Early Development 1 - Open

Indicator Species

Description

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

Dominant species are those common to the northern mixed-grass prairie and include *Hesperostipa comata*, *Nasella viridula*, *Andropogon gerardii*, *Bouteloua gracilis*, *Koeleria macrantha*, *Pascopyrum smithii*, *Buchloe dactyloides*, and maybe *Hesperostipa* *spartea*. Other grasses such as *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, NAVI4, HECO2, 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 can also be common in this class. This class has species that are grazing resistant, low growing, 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 greater than in other seral stages.

This might be a shortgrass Existing Vegetation Type A greater proportion of this class on the landscape today indicates departure.

The fuels in this class are generally too sparse and/or too short to carry fire.

This class lasts approximately 3yrs+. If in a prairie dog state, then the class takes lasts longer 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 3-yr interval attempts to capture what would happen post-fire or post-drought. (Also, post-heavy grazing in current conditions take longer to transition out of this class.)

The prairie dog stage increases in size during drought and grazing, then decreases during a wet cycle. It is a shifting mosaic of prairie dog movement and towns dependent on grazing and wet/dry cycles. Prairie dogs probably occupied between 15% and 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 also varies 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 Northern Great Plains vegetation would have prairie dog communities within an early successional stage of maximum 10-15% across an entire landscape. So, only a portion of the early successional stage is 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 mixed-grass prairie often is not much greater than 50cm. Note: Resolution of mapping may not be great enough to distinguish among classes.

Regular grazing occurs on a large part of the landscape each year.

Most of Class A cannot carry a fire if heavy grazing and drought are occurring as well as prairie dogs, so replacement fire is rare. Fire also does not set this stage all the way back to the beginning, considering the grasses resprout quickly. It takes fire, grazing, and drought to set it all the way back to the beginning (not technically modeled). Drought conditions can force this stage back to bare ground and annuals. Historically, however, there was very little of the annuals and shrubs component.

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

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

*Maximum Tree Size Class*  
None

Class B 69 Mid Development 1 - Open

Indicator Species

Description

Class B represents the intact historical 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.

Mixed grasses and forbs are dominant, woody vegetation (shrubs and trees) is widely scattered and limited to microsites 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 an arbitrary number. These classes should actually be defined on the ground by biomass, litter, and species. This class can be distinguished from Class A based on fuel model (3 for Class B vs. 1 for Class A) and biomass.

Replacement fire was modeled relatively frequently, but does not cause a transition back to the beginning, but some of the time causing a transition back to Class A. After fire, there is probably also heavy grazing. Little belowground mortality occurs after replacement fire, and resprouting of perennial grasses and forbs often occurs within days or weeks, depending on the season. Grasses show greater vigor; some forb establishment may occur as a result of exposure of mineral soil. Canopy cover recovers quickly after resprouting.

It has been suggested that grasshoppers and Mormon crickets might have had 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.

It would be uncharacteristic to have >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 start resprouting. Wyoming big sagebrush can also be a component (on shallower soils) of this BpS, although a small component. Fringe sagewort and rubber rabbitbrush may be present. Less common is skunkbush sumac, mostly on slopes and shallow soils.

Clubmoss 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, and sub-irrigated and wet meadow.

*Maximum Tree Size Class*  
None

Class C 6 Late Development 1 - Closed

Indicator Species

Description

Transition to Class C occurs due to lack of fire over an extended period of time. This shrubby stage might occur more on the eastern end of the MZs. Other species might include silverberry, quaking aspen (*Populus* *tremuloides*), willow (*Salix* spp.), cottonwood, boxelder, snowberry, and prunus, and can form dense thickets.

Grasses encompass open areas between stands of cedar. Shrubs and other climax species dominate, with an understory of fine fuels within the unburned area. Any areas within this class that do burn return to Class A conditions.

*Maximum Tree Size Class*  
None

Model Parameters

Deterministic Transitions

Probabilistic Transitions

Optional Disturbances

Optional 1: Heavy prolonged grazing including prairie dogs

Optional 2: Drought with grazing

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