

LANDFIRE Biophysical Setting Model

Biophysical Setting 3911320

Central Mixedgrass Prairie

☒ This BPS is lumped with: 1488

☐ This BPS is split into multiple models: Don't map 1488. In west 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)

Date 4/22/2007

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Vegetation Type

Upland
Grassland/Herbaceous

Dominant Species

HECO26
NAVI4

Map Zone

39

Model Zone

☐ Alaska
☐ California

☒ Northern Plains
☐ N-Cent. Rockies

General Model Sources

☒ Literature
☒ Local Data
☒ Expert Estimate

PASM
CAFI
KOMA
ANGE
SCSC
BOCU

☐
☐ Great Basin
☐ Great Lakes
☐ Hawaii
☐ Northeast

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

Geographic Range

This mixedgrass prairie system ranges from SD into the Rolling Plains and the Edwards Plateau of TX. The loessal regions in west-central KS and central NE, the Red Hills region of south-central KS and northern OK are all located within this system (NatureServe 2007).

In MZs 31 and 39, Central Mixedgrass Prairie (CES303.659) occurs in southwestern 39 and northeastern 31, in ECOMAP subsections 332Cd and 332Ca (interspersed within sandhills), 332Cc, 332Cf and 332Ce (Nebraska Loess Hills region) and it is prevalent within Rosebud Sioux Tribe Reservation and Eastern portions of Pine Ridge Indian Reservation. It might also be found in portions of 332Ch, but that is questionable, since it is more sandhills in that area. It is also found along the western Missouri River corridor north to Pierre and then just blends into shortgrass prairie (ECOMAP subsections 332Da, 332Df, 331Fe, 331Fv). The Central Mixedgrass Prairie is going to encompass part of MZ39 from southern SD and south – throughout the Central and Southern Great Plains (whereas BpS 1141 Northwestern Mixedgrass Prairie is the Northern version for Northern Great Plains). East of the Missouri River the Mixed Grass Prairie extends into ECOMAP section 332D (sand plains in northern part of 332Dg, east of Bassett) in areas of drier, more shallow soils where it blends in with the Western edge of the Northern Tall Grass Prairie. It also extends North to Highmore on the East side of the Missouri River. The Sandhills probably indicate the transition to Central versus Northern.

**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.

Biophysical Site Description

Elevations range from 1200-3000ft. Temperatures range between extremes of hot summers and cold winters that are typical of a continental climate. This system occurs in the 16-18in precipitation zone. In NE, ECOMAP section 332C, the rainfall is higher than this, approximately 20in or more east to west in subsections 332Cc, 332Cf and 332Ce. Most of the precipitation occurs during the growing season. Soils vary, but are generally mollisols. Soils in this BpS are formed from a diverse mixture of various sedimentary deposits. These soils range from clayey to loamy with sandy loams present in the western edge. Terrain consists of gently undulating hills to large expanses of flat open ground in central NE, this type occurs on loess soils with very rugged terrain.

Vegetation Description

This vegetation type is characterized by the dominance of grasses such as western wheatgrass and little bluestem on thin uplands. This system typically contains grass species such as *Bouteloua curtipendula*, *Schizachyrium scoparium*, *Andropogon gerardii*, *Hesperostipa comata*, *Sporobolus heterolepis* and *Bouteloua gracilis*, although the majority of the associations within the region are dominated by *Pascopyrum smithii* or *Schizachyrium scoparium*. Isolated patches of *Quercus macrocarpa* also can occur (NatureServe 2007).

This system includes elements from Western Great Plains Shortgrass (BOGR) and Western Great Plains Tallgrass systems (*Andropogon* spp), but these are probably just micro sites. Trees are limited to riparian areas and drainages which may be listed under a different BpS. Silver sage may be found in some floodplains. Other woody species include skunk brush sumac and snowberry, but these species are limited in abundance. Wild plum, buffaloberry and choke cherry are present in limited amounts throughout the area.

Disturbance Description

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. During dry conditions, there would be more grazing near permanent sources of water. During favorable conditions, grazers would graze further from permanent water sources.

It would be difficult for prairie dogs to move into an area without some kind of mechanism to reduce the vegetation, which could be drought, grazing or a combination of any. Under higher precipitation periods and with light grazing, grass grows quickly, and prairie dogs and other native ungulates might not be able to keep the grass down. Heavy ungulate grazing could create the right conditions for the prairie dog stage. Under favorable conditions, the prairie dog towns could even shrink because the vegetation is growing so fast. During dry conditions, short stature vegetation coupled with grazing can create more of a prairie dog community. Dry conditions can also set the stage for fire, which might then homogenize the landscape. Then the regrowth areas would be nutritious and palatable for the grazers. In wet cycles, there is broader grazing, as grazers would venture from permanent sources of water (Jack Butler, USFS, pers comm.).

MZ39 and MZ40 modelers recognized a varied degree of grazing pre-European settlement due to bison migration and other ungulates. Heavy grazing would move the community back to earlier stages.

Local site heterogeneity occurs on an even smaller scale, such as with bison wallows – which could even create ephemeral wetlands and a mesic situation. Carcasses could even create heterogeneity. There is also patch grazing occurring, and repeated re-grazing, which is enhanced by urine deposition, and an increased chance of re-grazing. Patch grazing creates a mosaic. It is possible that fire could homogenize an area from the preceding patch mosaic (Jack Butler, USFS, pers comm.).

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Historically, there were likely close interactions between fire and grazing since large ungulates (i.e.: bison) tend to be attracted to post-fire communities. Average fire intervals are estimated at five to 15yrs, with the average probably 8-10yrs. Lightning fires were most common in July and August, but probably occurred from about April to September. Seasonality of fires influences vegetation composition. Recurring early season fires (April - May) tend to favor warm-season species, while late season fires (August - September) may affect grass species relatively equally. Cool season grasses begin to cure in mid June, making fire more likely in late summer than earlier in the growing season. Fires historically could occur at any time of year, but most likely more common in late summer if dry and in early fall after frost and then again in early spring prior to green up.

Native American fires were prevalent in and around encampments for the purpose of driving animals and in some instances escaped cooking or warming fires.

Replacement fire in our model does remove 75% of the aboveground cover as assumed in the literature. However, MZ39 and MZ40 modelers did not think that loss of the aboveground cover by the replacement fire will necessarily induce retrogression back to an earlier seral stage because the main component of dominant grasses remains unharmed to insure the continuity of the seral stage. However, fire will significantly reduce cover for a season or two. Forb species are often more prevalent for the first few years as well.

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

From instrumental weather records, droughts average about one in every 10yrs, but droughts are often semi-periodic lasting three to four years in 30-40yr cycles.

Adjacency or Identification Concerns

This system is bordered by the shortgrass prairie on its western edge and the tallgrass prairie to the east. In MZs 31 and 39 in some areas, this also transitions in the west to 1141 (Northwestern Mixedgrass Prairie). From SD to ND, there is also tallgrass. Tallgrass is from ECOMAP subsection 251Aa to the East.

This system is also found along the western Missouri River corridor north to Pierre and then just blends into shortgrass prairie. The shortgrass prairie is predominantly western wheatgrass, blue grama and buffalograss.

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. Please see "Geographic" section above for information. Central Mixedgrass 1132 adheres to the Central and Southern Great Plains, whereas Northwestern Great Plains Mixedgrass 1141 adheres to Northern Great Plains. BpS 1141 excludes the sandhills and goes from northern NE and west to central MT 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.

The distinction between BpS 1132 and 1141 might also be based on the shift between cool and warm

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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.

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).

Current conditions in Loess Hills grassland system is degraded by chronic improper grazing with lots of C3 exotic grasses having replaced former C4 dominants.

Typical to this region is the encroachment of eastern red cedar. Many unmanaged landscapes are becoming totally dominated by red cedar. Differing tribal management practices can influence the degree of encroachment, particularly along the Missouri River. Many introduced species such as smooth brome, Kentucky bluegrass, Canada thistle and Japanese brome, are increasing. Sweet clover, biannual, can increase during wet springs. Massive encroachment of other introduced species i.e. leafy spurge and red cedar. Cheatgrass currently is increasing in portions of this system. Cheatgrass is a winter annual and decreases under spring prescribed fire.

Plowing is occurring currently.

Landscape burning was much more prevalent in the past than today by either Native American burning or unsuppressed free burning wildfire.

There might be more of the early successional, shortgrass class (A) on the landscape today, due to introduced species and grazing.

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:

- 1) Conversion of grassland to cropland.
- 2) Introduced species, primarily crested wheatgrass, annual bromes, smooth brome etc. and sweetclover.
- 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 long-term 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 precip 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, versus midgrass would indicate a departure.

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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 introduced grass species (CRP lands). Current CRP practices are native vegetation. 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 succession 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 Indian grass.

Native Uncharacteristic Conditions

Scale Description

Fires probably ranged in size from 10s to 10,000s of acres. The variation depends on build-up of fuels which were influenced by precipitation and grazing. Extent of weather influences (wet-dry cycles) would have been very widespread. In the loess canyon regions and other areas where terrain is rugged, such as along the Missouri River, topography would influence spread of fire.

Local site heterogeneity occurs on an even smaller scale, such as with bison wallows – which could even create ephemeral wetlands and a mesic situation. Carcasses could even create heterogeneity. There is also patch grazing creating a mosaic. It is possible that fire could homogenize an area from the preceding patch mosaic (Jack Butler, USFS, pers comm.).

Issues/Problems

The model created by MZs 31 and 39 modelers was based upon a composite 26yrs of range management and prescribed fire monitoring, on the following Indian Reservations: Lower Brule, Crow Creek, Rosebud, Pine Ridge, Yankton and land of the Ponca Tribe of NE.

Comments

This model for MZs 31 and 39 was adapted from the model from the same BpS 1132 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

****Fire Regime Groups are:** I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Class A 30 %

Early Development 1 Open

Upper Layer Lifeform

- ☒ Herbaceous
☐ Shrub
☐ Tree

Fuel Model
1

Description

This is the immediate-post-disturbance-post-fire stage or the very short-stature vegetation resulting from disturbance or heavy ungulate grazing. The fuels in this class are generally too sparse and/or too short to carry fire.

A variety of forb species such as scarlet globemallow and curlycup gumweed are common in this class, and grasses can also be common. This class will have species that are grazing resistant and low growing and drought-tolerant.

Common grass species include blue grama, buffalograss, western wheatgrass and prairie junegrass. Fringed sagebrush can also be a component of this class. Prickly pear, man sage (ARLU), fringed sage and broom snakeweed occur in this class. Abundance of prickly pear is much higher than in other seral stages. Other species are SPCO and ARPU9.

This class was initially set to succeed to class B between three and seven years. However, reviewers questioned the low range of three years. It would succeed in three years only under favorable conditions – unless the site is occupied by prairie dogs, and then it would remain as a prairie dog stage. It 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. 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. This class was therefore set to succeed to B after six years, as per reviewer comments.

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. During dry conditions, there would be more grazing near permanent sources of water. During favorable conditions, grazers would graze further from permanent water sources. However, it would be difficult for prairie dogs to move into an area without some kind of mechanism to reduce the vegetation, which could be drought, grazing or a combination of any. (Jack Butler, USFS, pers comm.).

Data from prairie dog towns (early seral, aka class A) suggest cover ranges from 0-80%. Height is 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.

Indicator Species and Canopy Position

ARFR4
Lower
BOGR2
Upper
PASM
Upper
BUDA
Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	40 %
Height	Herb 0m	Herb 0.5m
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

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Drought combined with grazing was modeled as Optional 2. This occurs on 1.2% (.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.

Replacement fire occurs every 5-10yrs. However, reviewer questioned this interval, as this class and fire is driven more by wet/dry cycles. Most of class A couldn't carry a fire if heavy grazing and drought are occurring as well as prairie dogs. Therefore, this was changed 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.

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.

Class B 65 %		<u>Indicator Species and Canopy Position</u>	<u>Structure Data (for upper layer lifeform)</u>												
Mid Development 1 Open		BOGR2	<table><tr><td></td><td><i>Min</i></td><td><i>Max</i></td></tr><tr><td><i>Cover</i></td><td>41 %</td><td>100 %</td></tr><tr><td><i>Height</i></td><td>Herb 0m</td><td>Herb 1.0m</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>	41 %	100 %	<i>Height</i>	Herb 0m	Herb 1.0m	<i>Tree Size Class</i>		
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<i>Cover</i>	41 %	100 %													
<i>Height</i>	Herb 0m	Herb 1.0m													
<i>Tree Size Class</i>															
<u>Upper Layer Lifeform</u>		Mid-Upper	☐ Upper layer lifeform differs from dominant lifeform.												
☒ Herbaceous		PASM													
☐ Shrub		Upper													
☐ Tree	<u>Fuel Model</u>	CAFI													
	3	Middle													
		SCSC													
<u>Description</u>		Middle													

Blue grama, western wheatgrass, needlegrasses, prairie junegrass, upland sedges and little bluestem are common grasses. In some areas species such as big bluestem and prairie sandreed are locally common. Western wheatgrass and little bluestem are the most common species as this class ages. In some areas, western wheatgrass forms dense stands.

Common forbs include scurfpea, prairie coneflower, Rocky Mountain beeplant, scarlet globemallow and dotted gayfeather. Prickly pear, man sage (*Artemisia ludoviciana*), fringed sage, snowberry and broom snakeweed occur in this class. Also, *Agropyron smithii* is present.

Cover in this class would actually range from 40-80%, depending on soils and weather for the year and the addition of the third class to account for abnormally long periods of low fire activity.

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

Replacement fire occurs approximately every ten years. It 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.

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

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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.

Class C 5 %	<u>Indicator Species and Canopy Position</u> PRVI Mid-Upper SYOC Lower JUVI Upper PASM Lower	<u>Structure Data (for upper layer lifeform)</u> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">Min</th> <th style="text-align: center;">Max</th> </tr> </thead> <tbody> <tr> <td>Cover</td> <td style="text-align: center;">11 %</td> <td style="text-align: center;">60 %</td> </tr> <tr> <td>Height</td> <td style="text-align: center;">Shrub 0.6m</td> <td style="text-align: center;">Shrub >3.1m</td> </tr> <tr> <td>Tree Size Class</td> <td colspan="2"></td> </tr> </tbody> </table> ☒ Upper layer lifeform differs from dominant lifeform. Grasses encompass open areas between stands of cedar.		Min	Max	Cover	11 %	60 %	Height	Shrub 0.6m	Shrub >3.1m	Tree Size Class		
	Min	Max												
Cover	11 %	60 %												
Height	Shrub 0.6m	Shrub >3.1m												
Tree Size Class														

Upper Layer Lifeform

- ☐ Herbaceous
☒ Shrub
☐ Tree

Fuel Model
2

Description

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 or in areas that are more protected from fire such as ravines in the deep loess regions.

Shrubs and other climax species would dominate with an understory of fine fuels 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 2% of the class each year.

Replacement fire occurs approximately every 10yrs.

Class D 0 %	<u>Indicator Species and Canopy Position</u> [Not Used] [Not Used]	<u>Structure Data (for upper layer lifeform)</u> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">Min</th> <th style="text-align: center;">Max</th> </tr> </thead> <tbody> <tr> <td>Cover</td> <td style="text-align: center;">%</td> <td style="text-align: center;">%</td> </tr> <tr> <td>Height</td> <td></td> <td></td> </tr> <tr> <td>Tree Size Class</td> <td colspan="2"></td> </tr> </tbody> </table> ☐ Upper layer lifeform differs from dominant lifeform.		Min	Max	Cover	%	%	Height			Tree Size Class		
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Height														
Tree Size Class														

Upper Layer Lifeform

- ☐ Herbaceous
☐ Shrub
☐ Tree

Fuel Model

Description

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Class E 0 %

[Not Used] [Not Used]

**Indicator Species and
Canopy Position**

Structure Data (for upper layer lifeform)

	<i>Min</i>	<i>Max</i>
<i>Cover</i>	%	%
<i>Height</i>		
<i>Tree Size Class</i>		

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 10000
Min 10
Max 100000

Sources of Fire Regime Data

- ☒ Literature
☒ Local Data
☒ Expert Estimate

Additional Disturbances Modeled

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

Fire Intervals

	<i>Avg FI</i>	<i>Min FI</i>	<i>Max FI</i>	<i>Probability</i>	<i>Percent of All Fires</i>
<i>Replacement</i>	8	2	30	0.125	100
<i>Mixed</i>					
<i>Surface</i>					
<i>All Fires</i>	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.

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