

LANDFIRE Biophysical Setting Model

Biophysical Setting 4114120

**North-Central Interior Sand and Gravel
Tallgrass Prairie**

- ☐ This BPS is lumped with:
☐ This BPS is split into multiple models:

General Information

Contributors (also see the Comments field)

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Vegetation Type

Upland
Grassland/Herbaceous

Dominant Species

SCSC
SONU2

Map Zone

41

Model Zone

☐ Alaska
☐ California
☐ Northern Plains
☐ N-Cent. Rockies

General Model Sources

- ☒ Literature
☐ Local Data
☒ Expert Estimate

BOCU
HESP11

☐ Great Basin
☒ Great Lakes
☐ Hawaii
☐ Northeast
☐ Pacific Northwest
☐ South Central
☐ Southeast
☐ S. Appalachians
☐ Southwest

Geographic Range

This BpS would have occurred in Sections/Subsections 222L (all-highest concentration would have been in this Section), 222K(all), 222R(all), 251Ba and 222M (al). Largest expanse (11-13 million ha) of this type is found across Central Midwestern states with typical Prairie Border forests and Prairie Peninsula region of eastern states IA, MN, WI, IL, IN, KY and OH.

Biophysical Site Description

Within the area of the Prairie Border forests (Abrams 1992), prairie vegetation dominated the landscape with oak-hickory forests existing within fire-protected ravines or along stream corridors forming gallery forests (Abrams 1992). Our model abstracts prairie types to include xeric and dry-mesic types (Curtis 1959). Xeric prairies were maintained by shallow soils (<4in) on steep slopes (usually to the southwest) with extreme runoff of rainwater. Xeric prairies may also have occurred on flat uplands where soil is shallow and has low water holding capacity. In general these prairie types are found in both glaciated and non glaciated areas. They are excessively to well drained, with shallow depth to bedrock or sandy soils. Fertility ranges from poor acidic to richer neutral soils limited by moisture. Thin loess over bedrock is prevalent in western ranges of this type in WI. This type is most prevalent in driftless areas with sharper topography but also occurs in glaciated areas among glacial till and outwash and well-drained sand and gravel deposits. Level sites occurred on glacial outwash with a very porous subsoil of sand and gravel. Rolling areas were characterized by glacial till of recessional moraines or on residual loess soils. While the region is strongly influenced by dry continental air flow patterns and periodic drought, historic fire

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frequency determined the prairie-forest boundary with much variation based on topography, fuel breaks, ignition sources and climate (Anderson and Bowles 1999, Whitney 1994). Over time, forest edges expanded and contracted based on topographic variability and fire frequency and intensity exhibiting a continuum of grassland, “grub”, open savanna woodlands, or canopied forests. Much has been written concerning these systems and excellent reviews can be found in Curtis (1959), Whitney (1994) and Anderson, and Fralish and Baskin (1999).

Vegetation Description

Grasses formed the matrix of the prairie with sideoats grama (*Bouteloua curtipendula*) and little bluestem (*Schizachyrium scoparium*) being the main indicator species. Big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), needlegrass (*Hesperostipa spartea*), and prairie dropseed (*Sporobolus heterolepis*) also dominate many dry to dry-mesic prairies (Whitney 1994). Numerous forbs such as composites--*Aster* spp., *Silphium* spp., blazingstars (*Liatris* spp.), and coneflower (*Echinacea pallida*), legumes--prairie clovers (*Petalostemum* spp.), roundheaded bushclover (*Lespedeza capitata*) and leadplant (*Amorpha canescens*) amongst many others, were also present. Fuel complexes consisted of short- or tall-grass prairie forbs and shrubs with little or no tree regeneration.

Oak grubs and shrubs characterize that portion of this vegetation sequence that experienced recurring fires in advanced oak regeneration, which stimulates the resprouting response evidenced by the ‘grubs’ or multi-stemmed stump sprouts of black oak (*Q. velutina*), bur oak (*Q. macrocarpa*), white oak (*Q. alba*) and others (Abrams 1992). Shrub species include New Jersey tea (*Ceanothus americanus*), hazelnut (*Corylus americana*), gray dogwood (*Cornus racemosa*) and sumac (*Rhus* spp.). Over a period of years, massive root systems developed, and the term ‘grub’ (from the German gruben, ‘to dig’), referenced the laborious method of removing these root wads in clearing areas for planting (Anderson and Bowles 1999). Fuel complexes were characterized as “stunted brush prairie” comprised of mixed prairie grasses and forbs with coppicing oak stems about 1-1.5m in height (Curtis 1959, Anderson and Bowles 1999).

Savannas and woodlands represent relatively open forest systems along the prairie-forest continuum (for extreme variety see Anderson et al. 1999). Generally, these systems have example species from true open prairies, woodlands, and closed canopy forests, with oak species dominating the arboreal layer (Abrams 1992). For the purposes of FRCC we have adopted fairly average canopy closure values of 0-10% closure for prairie, 10-25% closure to indicate savanna, while woodlands exhibit 25-60% canopy closure (see discussion in Anderson and Bowles 1999 for variation across range).

Disturbance Description

Frequent fires impacted this prairie system every 1-5yrs, maintaining grass and forb vegetation. Insect and small mammal herbivory impacts composition and dominance (Howe et al 2006). Large mammals were present in low densities, main grazers were elk and deer with impacts likely being minimal.

Shrub and tree establishment and longevity was influenced by fire intensity and return interval.

Fire intensity will be influenced by topography, weather, productivity and aspect. For example, productive soils on level terrains supported more intensive fires and the areas with fire breaks or leeward sides/north-facing slopes generally supported more savanna types. Fire intensity varied based on humidity and temperature. Fire intensity also varies with aspect and slope. For example south and west facing steep slopes would have burned at a higher intensity resulting in few trees and shrubs.

Oak wilt occurred on sand prairies and likely resulted in mortality of larger oak groups especially when they occurred in high densities. This was not modeled due to the general lack of larger oak groups in this

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BpS.

Diseases and insects can impact species composition. However, specific impacts are not clearly understood and therefore not modeled.

Within the western ranges of this type in WI and MN, there was a grazing and fire interaction. This was probably minimal in the MZs 41, 50 and 51, since those are more eastern. As one moves east in this region fire increases to where it is the major disturbance factor for this type and grazing drops out as an influence.

Proximity of seed source is important to probability of shrub and tree invasion. Proximity is related to isolation of trees/ shrubs. Less edge equals lower probability of tree/shrub invasion.

Health and vigor of the sod influences shrub/tree invasion. Better health of sod reduces probability of successful establishment of trees and shrubs.

Adjacency or Identification Concerns

North-central interior oak savanna, north-central oak barrens, central tallgrass prairie and adjacent sedge meadows and wet prairie are the systems that would be adjacent to this BpS.

Synonymous local classifications include bluff prairie, hill prairie, sand prairie, limestone prairie and dry prairie.

This BpS might be confused with the central tallgrass prairie systems.

In the absence of historic fire invasive problems have increased dramatically, including eastern red cedar (*Juniperus virginiana*). Exotics that have become invasive due to agricultural practices and roadside plantings include leafy spurge (*Euphorbia esula*), knapweed, sweet clover (*Melilotus alba*), and crown vetch and birds foot trefoil. Domestic livestock grazing is also an issue.

Today this system has severely reduced native cover (approx. 99% loss) due to conversion to other uses such as agriculture. Altering of the type is due to grazing and reduced fire resulting in greater shrub and tree component (red cedar (*Juniperus virginiana*), oak species (*Quercus* spp.) and a variety of native and non native shrubs, and non native cool season grasses (brome, bluegrass, quackgrass and redbud) resulting in reduced diversity.

Agriculture on level sand prairie where irrigation will support crops is a type conversion that might be present today such that the historical condition is unidentifiable. Invasion of cool season grasses and shrubs often mask the identification of this type.

Again, species composition and structure was dependent on local factors such as topography, soil conditions, fire regime, plant competition and plant-animal interactions (Anderson and Bowles 1999).

Native Uncharacteristic Conditions

Many small trees and shrubs would be uncharacteristic of this system historically but occurs today due to the lack of fire. Domestic livestock grazing has eliminated many native species and has altered species composition. There is not much of the grassy stages left due to altered fire regimes and with grazing the species have shifted.

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Scale Description

Within regions of varied topography, type patches are typically small (<200ac) limited by topography, but in regions of level topography on extensive sands and gravel deposits these could be much larger.

Issues/Problems

The plant/animal interactions are not fully understood for this model and numerous studies of these phenomena are ongoing. Research exists for bison/fire interaction in detail. Also, there is possible overlap with the North-Central Interior Oak Savanna model. There is variation in oak species composition across the broad region covered by this model (i.e., bur oak [*Quercus macrocarpa*] occurs in the western portion of the range).

There is also great variation in prairie type across the Great Lakes region (MZs 41, 50 and 51). For instance, within the western ranges of this type in Wisconsin and Minnesota, there was an interaction between grazing and fire disturbances. This was probably minimal in the MZs 41 and 50, since those are more eastern. As one moves east in this region fire increases to where it is the major disturbance factor for this type and grazing drops out as an influence. Also, the species composition also changes from east to west; therefore, this is hard to model as one type.

For all oak systems, oak wilt is becoming more wide-spread due to an increased number of mature oaks, and the amount of wood being moved around.

Comments

Additional review was provided by Tim Christiansen (tim.christiansen@us.army.mil). Model was reviewed at the Vegetation Modeling Workshop by Elena Conteras, Randy Swaty, Mike Kost, Chris Weber, Doug Cox and Becky Schillo.

This model for GL was adapted from the Rapid Assessment model R6BSOH Mosaic of Bluestem Prairie and Oak-Hickory created by C Emanuel cemanuel@tnc.org, S Hickey shickey@tnc.org and D. Minney dminney@tnc.org.

This model for the Rapid Assessment was created 5/26/04 for the Fire Regime Condition Class (FRCC) Interagency Handbook. An additional modeler was involved in this process, Charles Ruffner. The original document was coded BLST1 and then subsequently BLST2 for the FRCC code. The original model was altered in the Rapid Assessment Workshop (1/24/05) by Todd Hawbaker (tjhawbaker@wisc.edu) and Tricia Knoot (tknoot@iastate.edu). Please see RA model for details about class percentages changed and altered.

Vegetation Classes

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Class A 82 %

Early Development 1 Open

Upper Layer Lifeform

- ☒ Herbaceous
☐ Shrub
☐ Tree

Fuel Model
3

Description

Grasses formed the matrix of the prairie with big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), needlegrass (*Hesperostipa spartea*), prairie dropseed (*Sporobolus heterolepis*) and sideoats grama (*Bouteloua curtipendula*) dominating many dry to dry-mesic prairies (Whitney 1994). Numerous forbs such as composites--*Aster* spp., *Silphium* spp., blazingstars (*Liatris* spp.), and coneflower (*Echinacea pallida*), legumes--prairie clovers (*Petalostemum* spp.), roundheaded bushclover (*Lespedeza capitata*) and leadplant (*Amorpha canescens*) amongst many others, were also present. Fuel complexes consisted of short- or tall-grass prairie forbs and shrubs with little or no tree regeneration. Fuel complexes consisted of short- or tall-grass prairie forbs.

Replacement fires occur frequently in early successional seral class A (modeled at the probability of occurring every 3-4yrs) and maintain the system in class A. Grass cover in this stage truly should be in the high cover ranges. If it were lower, it would be a different area/system.

This class would go to class B if fire and seed source were unavailable (modeled as alternate succession at a 0.008 probability or the probability of occurring every 130yrs). We would like to model this as time since disturbance without a probability; however, that's unallowable. So - we just modeled with a probability. Also distance to seed (from birds, wind, small mammals) would influence whether we get to B or not without fire.

Small mammals and invertebrates and tree pathogens such as oak wilt probably occurred historically, but unsure of impact, so they were not modeled.

This A class is the grass type and was very common historically, but not currently.

Indicator Species and Canopy Position

SCSC
Upper
SONU2
Upper
BOCU
Upper
HESP11
Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	100 %
Height	Herb 0m	Herb >1.1m
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Additional species include prairie dropseed, big bluestem.

Class B 15 %

Mid Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
☒ Shrub
☐ Tree

Fuel Model
1

Description

This is the shrub-oak grub representing prairie with scattered shrub and seedling sprouts or grubs. This vegetation is experiencing recurring fires in advanced oak regeneration, which stimulates the resprouting grubs. Fuel complexes are characterized as "stunted brush prairie" comprised of mixed prairie grasses and

Indicator Species and Canopy Position

BOCU
Low-Mid
SCSC
Middle
COAM3
Upper
CORA6
Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	50 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	Seedling <4.5ft	

☒ Upper layer lifeform differs from dominant lifeform.

Perennial grasses dominate this class with <50% oak/shrub canopy.

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forbs with shrubs and coppicing oak stems about 1-1.5m in height (Curtis 1959; Anderson and Bowles 1999).

This is the brush-phase that occurs without fire. A replacement fire, modeled with the probability of occurring every 25yrs, could take system back to class A. A replacement fire, modeled with the probability of occurring every 4-5yrs would maintain the system in class B. If the system where to through a real drought then fire would be more effective in reducing the shrub component and sending the system back to class A. In an average year, fire would set back shrub growth but they would resprout. There would have to be the right conditions of drought and fire to truly set the system back to class A. Also, it would have to be a very intense frequent fire to take this class back to A. However, if shrubs are just starting to come in, it might be easier to get back to A.

Fire frequency in general is the same as class A, but the intensity and right site conditions is what would transition this stage back to A.

Severe drought cycles, modeled as a wind/weather/stress event, occur approximately every 30-ish years. Therefore, if we get enough fire around these drought events, the fire might take this stage back to A - especially if shrubs are in the beginning stage - if lower canopy cover, would go back to A. It's questionable as to whether or not a filled-up-shrub stage would go all the way back to A, might just set back a bit. Fire modeled as having the ability to take back to A with 0.017 probability. It is questionable as to whether this stage is truly part of this system or whether it's transitioned to another type.

B can go to C, modeled through alternate succession if there is a seed source combined with weather conditions and lack of fire. Therefore it was modeled with a probability of 0.010 or of occurring every 100yrs.

Surface fires are possible in this stage, because as the shrubs get taller, it's surface fire that will creep along the grass and not topkill the shrubs. As we get more surface fire, this class actually moves to C.

Class C	3 %	<u>Indicator Species and Canopy Position</u>	<u>Structure Data (for upper layer lifeform)</u>												
Mid Development 2 All Structures		BOCU	<table><tr><td></td><td><i>Min</i></td><td><i>Max</i></td></tr><tr><td><i>Cover</i></td><td>11 %</td><td>20 %</td></tr><tr><td><i>Height</i></td><td>Tree 0m</td><td>Tree 10m</td></tr><tr><td><i>Tree Size Class</i></td><td colspan="2">Pole 5-9" DBH</td></tr></table>		<i>Min</i>	<i>Max</i>	<i>Cover</i>	11 %	20 %	<i>Height</i>	Tree 0m	Tree 10m	<i>Tree Size Class</i>	Pole 5-9" DBH	
	<i>Min</i>	<i>Max</i>													
<i>Cover</i>	11 %	20 %													
<i>Height</i>	Tree 0m	Tree 10m													
<i>Tree Size Class</i>	Pole 5-9" DBH														
<u>Upper Layer Lifeform</u>		COAM3													
☐ Herbaceous		Middle													
☐ Shrub		QUERC													
☒ Tree	<u>Fuel Model</u>	Upper	☒ Upper layer lifeform differs from dominant lifeform.												
	1	SCSC	Perennial grasses dominate this class with a 11% maximum tree canopy - LANDFIRE rules made us increase the maximum to 20%. Above this percent this system often moves to north-central oak savanna. Juniperus virginiana is also a prominent small tree on the driest prairies.												
<u>Description</u>		Low-Mid													

This box would rarely occur, and would not ever come back to prairie unless there is a catastrophic fire with high intensity, or having extremely intense fires successively, or time of year/seasonality could influence going back to A, which might have occurred but very infrequently. Replacement fire, modeled with the probability of occurring every 200yrs, could take the class back to class A. C class is more common today, but

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not historically.

Fuel complexes for savanna areas were largely prairie grasses and forbs in the understory with widely scattered fire-resistant shrub and oak stems forming the overstory.

After you get over 20%, this goes into other system.

Class C would have surface fires because it's a tree/shrub system which won't get topkilled.

Replacement fires could happen under the right conditions to take it all the way back to A, but would be very unlikely. Replacement fires, modeled at the probability of occurring every 25yrs, could also take this class back to B under the right conditions. This would happen when there is enough fire intensity to top kill the trees, but not enough successive fires to take this box back to all grass (box A).

Drought would increase the fire effect in this class.

Class D	0 %	<u>Indicator Species and Canopy Position</u>	<u>Structure Data (for upper layer lifeform)</u>
[Not Used]	[Not Used]		
<u>Upper Layer Lifeform</u>			
☐ Herbaceous			
☐ Shrub			
☐ Tree			
<u>Fuel Model</u>			
			☐ Upper layer lifeform differs from dominant lifeform.

Description

Class E	0 %	<u>Indicator Species and Canopy Position</u>	<u>Structure Data (for upper layer lifeform)</u>
[Not Used]	[Not Used]		
<u>Upper Layer Lifeform</u>			
☐ Herbaceous			
☐ Shrub			
☐ Tree			
<u>Fuel Model</u>			
			☐ Upper layer lifeform differs from dominant lifeform.

Description

Disturbances

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Fire Regime Group:** II

Historical Fire Size (acres)

Avg 200

Min 1

Max 2000

Sources of Fire Regime Data

- ☐ Literature
☐ Local Data
☒ Expert Estimate

Additional Disturbances Modeled

- ☐ Insects/Disease ☐ Native Grazing ☐ Other (optional 1)
☒ Wind/Weather/Stress ☐ Competition ☐ Other (optional 2)

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	3.610	1	8	0.277	96
Mixed					
Surface	90			0.01111	4
All Fires	3			0.28812	

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

- Abrams, M.D. 1992. Fire and the development of oak forests. *Bioscience*. 42: 346-353.
- Anderson, R.C. and M. L. Bowles. 1999. Deep-soil savanna and barrens of the Midwestern United States. In: Anderson, R.C., J.S. Fralish, and J.M. Baskin, eds. *Savanna, Barrens, and Rock Outcrop Communities of North America*. Cambridge University Press, Cambridge, UK: 155-170.
- Anderson, R.C., J.S. Fralish and J.M. Baskin, eds. 1999. *Savanna, Barrens, and Rock Outcrop Communities of North America*. Cambridge University Press, Cambridge, UK.
- Curtis, J.T. 1959. *The Vegetation of Wisconsin*. University of Wisconsin, Madison, WI.
- Howe, H. F., B. Zorn-Arnold, A. Sullivan and J.S. Brown. 2006. Massive and distinctive effects of meadow voles on grassland vegetation. *Ecology*. 87: 3007-3013.
- NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of 10 February 2007.
- Transeau, E.N. 1935. The prairie peninsula. *Ecology* 16: 423-437.
- Whitney, G.G. 1994. *From Coastal Wilderness to Fruited Plain: a history of environmental change in temperate North America from 1500 to the present*. Cambridge University Press, Cambridge, UK.
- USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, Kuchler Type: Mosaic of bluestem prairie and oak-hickory forest. <<http://www.fs.fed.us/database/feis/>>.

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