LANDFIRE Biophysical Setting Model

***Biophysical Setting:* 4914120** **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) **Date** 11/26/2007

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Vegetation Type
Upland Grassland/Herbaceous

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Dominant Species
SCSC
SONU2
BOCU
HESP11

Map Zone
49

Model Zone
☐ Alaska
☐ California
☐ Great Basin
☑ Great Lakes
☐ Hawaii
☐ Northeast
☐ Northern Plains
☐ N-Cent.Rockies
☐ Pacific Northwest
☐ South Central
☐ Southeast
☐ S. Appalachians
☐ Southwest

Geographic Range

This BpS occurs on glacial features such as kames, eskers, moraines, sandplains, along eolian dunes, and on lakeplains, excluding the Great Lakes, in the northern Midwest, primarily MN, WI, and MI (NatureServe 2007). In MZ49, this system was likely of local occurrence, where North-Central Interior Sand and Gravel Tallgrass Prairie would have occupied small patches in a matrix of mesic prairie, oak savanna and oak-hickory forest. The (Kankakee) Sand Area Level IV Ecoregion within the Eastern Corn Belt Plains may have supported the largest examples of this BpS in MZ49 (Homoya et al. 1985, Woods et al. 1998, Woods et al. 2006). Elsewhere, this BpS occupied sand deposits and sand or gravel substrates on slopes or river bluffs.

Biophysical Site Description

Within MZ49, North-Central Interior Sand and Gravel Tallgrass Prairie occupied kames, eskers, moraines, lakeplains and sandplains characterized by a sandy, rocky, or gravelly substrate. This BpS was likely concentrated in the Kankakee Sand Area Level IV Ecoregion in NW Indiana and NE Illinois (Woods et al. 1998, 2006). The BpS also occurred locally elsewhere in this map zone, where substrate and natural disturbances favored the development of sand and gravel prairie. This model abstracts prairie types to include xeric and dry-mesic types (Curtis 1959).

Vegetation Description

Sand and gravel prairies support drought-tolerant species, including many species that are typical of acidic substrates (particularly on sand deposits). Typical dominant grasses are little bluestem (Schizachyrium

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scoparium), Indian grass (Sorghastrum nutans), porcupine grass (Stipa spartea) and sideoats grama (Bouteloua curtipendula). The driest sites on sand deposits may contain sand reed (Calamovilfa longifolia), and dry-mesic sites often contain big bluestem (Andropogon gerardii) and prairie dropseed (Sporobolus heterolepis), the latter two species more characteristic of BpS 1421 (White and Madany 1978, Jacquart et al. 2002, NatureServe 2007).

Other characteristic species in this system include goat's rue (Tephrosia virginiana), prickly-pear (Opuntia humifusa), western ragweed (Ambrosia psilostachya), flowering spurge (Euphorbia corollata), panic grasses (Panicum oligosanthes, P. virgatum, Dichanthelium villosissimum), pale purple coneflower (Echinacea pallida), hairy puccoon (Lithospermum caroliniense), June grass (Koeleria macrantha), clustered poppymallow (Callirhoe triangulata), purple prairie clover (Dalea purpurea), old field goldenrod (Solidago nemoralis), showy goldenrod (S. speciosa), slimflower scurf-pea (Psoralidium tenuiflorum), azure aster (Symphyotrichum oolentangiense var. oolenangiense), leadplant (Amorpha canescens), fragrant sumac (Rhus aromatica) and birdfoot violet (Viola pedata) (White and Madany 1978, Jacquart et al. 2002, McClain et al. 2005, Corbett and Anderson 2006, NatureServe 2007).

Oak grubs and shrubs are common this system. Recurring fires in advanced oak regeneration 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 1-1.5 m 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

Historically, before European settlement, 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 stands in this BpS.

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

Within MZ49, there was a grazing and fire interaction. Heavy grazing reduces fuels available for fire. 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, gravel prairie, limestone prairie, dry prairie

This BpS might be confused with the Central Tallgrass Prairie System.

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), 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, redtop) 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.

Scale Description

Within regions of varied topography, patches are typically small (<200ac) limited by topography, but in

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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 and the North-Central Oak Barrens model. Both savanna Systems occur in the range of this model and a site can move from this prairie BpS to either of the savannas or back depending on fire regime.

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 Jim Drake (jim_drake@natureserve.org), Tim Christiansen (tim.christiansen@us.army.mil) and Steve Richter (srichter@tnc.org). Model was reviewed at the Vegetation Modeling Workshop by Elena Conteras, Randy Swaty, Mike Kost, Chris Weber, Doug Cox, and Becky Schillo. Text was adapted for MZ52 by B. Slaughter on 11/26/07.

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, 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

Class A **82 %**

Early Development 1 Open

Upper Layer Lifeform

- [x] Herbaceous
- [ ] Shrub
- [ ] Tree

Fuel Model

3

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 and big bluestem.

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 heterolepsis) 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.

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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.

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

Class B **15 %**

Mid Development 1 All Structures

Upper Layer Lifeform

- [ ] Herbaceous
- [x] Shrub
- [ ] Tree

Fuel Model

1

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	

- [x] Upper layer lifeform differs from dominant lifeform.

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

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 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 were to go 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 back to class A. However, if shrubs are just starting to come in, it might be easier to get back to class A.

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

**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.

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 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 %**

Mid Development 2 All Structures

Upper Layer Lifeform

- [ ] Herbaceous
- [ ] Shrub
- [x] Tree

Fuel Model

1

Indicator Species and Canopy Position

BOCU
Lower
COAM3
Middle
QUERC
Upper
SCSC
Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	20 %
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

- [x] Upper layer lifeform differs from dominant lifeform.

Perennial grasses dominate this class with an 11% maximum tree canopy-LANDFIRE rules made us increase the maximum to 20%. Above this percent, this system often moves to North-Central Interior Oak Savanna or North-Central Barrens. Juniperus virginiana is also a prominent small tree on the driest prairies.

Description

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. Class C is more common today, but 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 another 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.

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Class D **0 %**

[Not Used] [Not Used]

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model

Indicator Species and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class E **0 %**

[Not Used] [Not Used]

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model

Indicator Species and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

Disturbances

Fire Regime Group:** II

Historical Fire Size (acres)

Avg 200
Min 1
Max 2000

Sources of Fire Regime Data

- ☐ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	3.595	1	8	0.27813	96
Mixed					
Surface	88.40			0.01131	4
All Fires	3			0.28945	

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.

Additional Disturbances Modeled

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

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**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.