13270
East Gulf Coastal Plain Northern Loess Bluff Forest

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Modelers		Reviewers	
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None	None	None	None
None	None	None	None

Vegetation Type
Forest and Woodland

Map Zones
45, 46, 47

Geographic Range
This system is endemic to the loess bluffs ("Bluff Hills" [Ecoregion 74a] of EPA (2004)) along the eastern edge of the Mississippi River Alluvial Plain from Kentucky southward through the upper two-thirds of Michigan. In map zone (MZ) 47, this corresponds to subsections 231Ha and 231He

Biophysical Site Description
Largely confined to steep bluffs east of the Mississippi River and excluding the loess plains immediately to their east. Consisting of a belt of Pleistocene and Tertiary eolian deposits (Braun 1950) that are often deeply eroded and very steep, with fertile topsoil and abundant moisture (Miller and Neiswender 1987). The core of this system is mapped as the Jackson Formation (Hardeman 1966) and corresponds more broadly with Ecoregion 74a (Bluff Hills) (EPA 2004). Examples may extend to 150m (500ft) in elevation and from 30 to 60m (100-200ft) above the adjacent Mississippi Alluvial Plain. In Tennessee the loess soils may be 9-27.5 m (30-90ft deep) (NatureServe 2006).

Vegetation Description
This system is usually a closed-canopy, multi-layered, forest. North of the range of Southern Magnolia (*Magnolia grandiflora*) which excludes the "Beech-Magnolia" forests of the southern loess bluffs, it is described elsewhere as dominated by Beech (*Fagus grandifolia*) or Beech-White Oak. That description possibly belies its diversity and overstates the overall importance of Beech in the canopy. Braun (1950) characterized the loess bluffs as mixed mesophytic forest, albeit modified in the southern loess bluffs by the occurrence of Southern Magnolia. Delcourt and Delcourt (1974) described a Louisiana portion similarly, while Loughridge (1888) called it "one of the heaviest and most varied of the original forest growths" at its northern extent in western Kentucky. Indeed, more than 50 tree species occur in the loess bluffs (Smith and Linnartz, 1980).

Beyond Beech and White Oak, significant canopy species include Swamp Chestnut, Cherrybark and Black Oaks, as well as non-oak species such as Sweetgum (*Liquidambar styraciflua*), Yellow-poplar (*Liriodendron tulipifera*), and Blackgum (*Nyssa sylvatica*), which are important throughout, and may totally replace oaks on the most mesic sites.

Subcanopy, and some canopy, species include American Hornbeam (*Carpinus caroliniana*), Eastern Hophornbeam (*Ostrya virginiana*), Red and Florida Maples (*Acer rubrum* and *A. barbatum*), Sourwood (*Oxydendrum arboretum*), Sassafras, Flowering Dogwood (*Cornus florida*), Persimmon (*Diospyros virginiana*), White Ash (*Fraxinus Americana*), Winged Elm (*Ulmus alata*), Basswood (*Tilia* spp.), Cucumber Tree (*Magnolia acuminate*), Loblolly Pine (*Pinus taeda*) (more southerly stands), and American Holly (*Ilex opaca*). These bluffs, as well as the southern bluffs, frequently provide habitat for species that are more common to the north (Delcourt and Delcourt 1975).

Other shrubs and woody vines include *Decumaria barbara, Rhododendron canescens, Toxicodendron radicans, Vitis rotundifolia*, and *Smilax glauca* (NatureServe 2006)

Important herbs include *Polystichum acrostichoides, Woodwardia areolata, Osmunda cinnamomea, Mitchella repens*, and *Hexastylis arifolia* (NatureServe 2006). In many cases, these bluffs provide habitat for plant species that are rare or absent from other parts of the Coastal Plain, such as *Magnolia acuminata, Aralia racemosa*, and *Hydrophyllum canadense* (Chester et al. 1997).

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
FAGR	*Fagus grandifolia*	American beech
QUAL	*Quercus alba*	White oak
QUVE	*Quercus velutina*	Black oak
LITU	*Liriodendron tulipifera*	Tuliptree
LIQUI	*Liquidambar*	Sweetgum
QUPA5	*Quercus pagoda*	Cherrybark oak
NYSY	*Nyssa sylvatica*	Blackgum
QUMI	*Quercus michauxii*	Swamp chestnut oak

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

Disturbance Description

Considered separately from the loess plains, the bluffs are stable, relatively fire sheltered forests. As modeled here, replacement disturbance is >60% and more likely due to weather related events than fire. Included among these are windthrow, lightning, and ice damage, as well as the inclusion of the erosion and mass wastage that give the bluffs their characteristic steepness. Widespread insect or disease mortality has not been reported. Wind/weather/stress replacement frequency is modeled near 240yrs, replacement fire return at approximately 385yrs, and all fire return frequency at about 85yrs. "Open" structure is uncommon, even when defined as canopy closure <81%, and may be created by mixed-severity fire. Surface fire may maintain open conditions, but it does not transition closed classes. Disturbance is presumed to mirror mixed mesophytic forest, occurring primarily in small gaps (<1/4 ac), although the occurrence of aggregates of intolerant species suggests that larger scale disturbances occasionally play a role.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	392	21	150	2000
Moderate (Mixed)	354	24	200	1300

Low (Surface)	151	55	100	350
All Fires	83	100		

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

The loess bluff forests are described by NatureServe (2006) as large patch communities. At the inferred scale of disturbance, a relatively small area of 100,000ac could capture the biophysical setting (BpS) mosaic.

Adjacency or Identification Concerns

There is a sharp transition along the western edge of the bluffs into the Mississippi River alluvial plain, and a more subtle gradient on the east into the loess plains. The latter division could be difficult to delineate floristically if forest cover remained intact on the plains. Although one physical distinction is topography, the others are depth of loessal soils, and moisture regime.

Similar ecological systems include the East Gulf Coastal Plain Southern Loess Bluff Forest (CES203.556 -- BpS1329) which occurs further southward in the East Gulf Coastal Plain and has greater dominance by broad-leaved and needle-leaved evergreen trees, Southern Coastal Plain Mesic Slope Forest (CES203.476 -- BpS1357), and East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest (CES203.477 -- BpS1325). There are other mixed deciduous mesic systems in the West Gulf Coastal Plain as well as other mesic forest systems to the east of this one, in areas other than the loess bluffs (NatureServe 2006).

Issues or Problems

For this BpS, the effect of surface fire is more reflected in the status of the sub-canopy than the overstory. However, since an open/closed distinction based on sub-canopy requires ground-based data, this model omits it, and only rarely allows mixed severity fire to create "open" stands. The result is a significant reduction in the percent displayed in open classes from previous models. Also, this BpS is sandwiched between the nonpyrophytic alluvial plain (Frost 1998) and the much drier loess plains which were home to significant aboriginal populations and thus, a heightened chance of fire. The degree of sheltering here is based on topography and a westerly approach of significant wind events.

Native Uncharacteristic Conditions

Comments

The models for MZs 45, 46, and 47 were identical by query, and the descriptions were virtually identical, except that MZ47 had slightly different fire regime intervals. Because these differences were small and considered insignificant, the models were collapsed (decision by J. Smith), and the description for MZ47 was used for all three map zones. The descriptions for MZs 45 and 46 were identical.

This model was developed for MZs 46 and 47. The Rapid Assessment model R9OADM served as a basis for development of the Vegetation Dynamics Development Tool model.

Succession Classes

Mapping Rules

Upper Layer Lifeform	Height (m)	Canopy Cover (%)									
		0-10	11-20	21-30	31-40	41 - 50	51-60	61-70	71-80	81-90	91-100
Herb	0-0.5	A	A	A	A	A	A	A	A	A	A
Herb	0.5-1.0	A	A	A	A	A	A	A	A	A	A
Herb	>1.0	A	A	A	A	A	A	A	A	A	A
Shrub	0-0.5	A	A	A	A	A	A	A	A	A	A
Shrub	0.5-1.0	A	A	A	A	A	A	A	A	A	A
Shrub	1.0-3.0	A	A	A	A	A	A	A	A	A	A
Shrub	>3.0	A	A	A	A	A	A	A	A	A	A
Tree	0-5	A	A	A	A	A	A	A	A	A	A
Tree	5-10	C	C	C	C	C	C	C	C	B	B
Tree	10-25	C	C	C	C	C	C	C	C	B	B
Tree	25-50	D	D	D	D	D	D	D	D	E	E
Tree	>50	D	D	D	D	D	D	D	D	E	E

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 10 Early Development 1 - All Structures

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAL	Quercus alba	White oak	Upper
FAGR	Fagus grandifolia	American beech	Upper
QUVE	Quercus velutina	Black oak	Upper
LITU	Liriodendron tulipifera	Tuliptree	Upper

Description

This class is characterized by sprouts, seedlings, and saplings, primarily of major overstory species, in gaps created by wind, lightning, soil slippage, insect/disease, and less frequently, fire. Shade intolerant species (e.g. *Liriodendron tulipifera*) are confined to multiple-tree gaps. Canopy closure is usually complete beyond the first 3-5yrs.

Maximum Tree Size Class

Sapling >4.5ft; <5"DBH

Class B 37 Mid Development 1 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAL	Quercus alba	White oak	Upper
FAGR	Fagus grandifolia	American beech	Upper
QUVE	Quercus velutina	Black oak	Upper
LITU	Liriodendron tulipifera	Tuliptree	Upper

Description
Class B is dominated by young to early mature canopy species with high canopy closure. A well-developed midstory is likely present, particularly at later ages of this class, in the absence of surface fire.

Maximum Tree Size Class
Medium 9-21"DBH

Class C **2** **Mid Development 1 - Open**

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAL	Quercus alba	White oak	Upper
FAGR	Fagus grandifolia	American beech	Upper
QUVE	Quercus velutina	Black oak	Upper
LITU	Liriodendron tulipifera	Tuliptree	Upper

Description
Similar to class B but with lower canopy closure and no established midstory. Surface fire may maintain open structure, but without it, or replacement disturbance, this class transitions to a closed state.

Maximum Tree Size Class
Medium 9-21"DBH

Class D **2** **Late Development 1 - Open**

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAL	Quercus alba	White oak	Upper
FAGR	Fagus grandifolia	American beech	Upper
QUVE	Quercus velutina	Black oak	Upper
LITU	Liriodendron tulipifera	Tuliptree	Upper

Description
This class characterized by an early to late mature canopy that may exceed 100ft in height. Canopy closure is less than full without well-developed lower layers. Dominant overstory

species vary depending on location and stand history. Surface fire maintains the system in this class. Similar to class C, this class closes barring other intervening transitions.

Maximum Tree Size Class
Large 21-33"DBH

Class E 49 Late Development 1 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
FAGR	Fagus grandifolia	American beech	Upper
QUAL	Quercus alba	White oak	Upper
QUVE	Quercus velutina	Black oak	Upper
LITU	Liriodendron tulipifera	Tuliptree	Upper

Description
This class exhibits higher canopy closure. This class often displays a multi-layered vertical structure except where an open understory has been maintained by light surface fire.

Maximum Tree Size Class
Large 21-33"DBH

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:CLS	15
Mid1:OPN	16	Late1:OPN	80
Mid1:CLS	16	Late1:CLS	80
Late1:OPN	81	Late1:OPN	999
Late1:CLS	81	Late1:CLS	999

Probabilistic Transitions

Disturbance Type	Disturbance occurs In	Moves vegetation to	Disturbance Probability	Return Interval (yrs)	Reset Age to New Class Start Age After Disturbance?	Years Since Last Disturbance
Replacement Fire	Early1:ALL	Early1:ALL	0.003	333	Yes	0
Mixed Fire	Early1:ALL	Early1:ALL	0.007	143	No	0
Alternative Succession	Mid1:OPN	Mid1:CLS	1	1	Yes	20
Wind or Weather or Stress	Mid1:OPN	Early1:ALL	0.004	250	Yes	0
Replacement Fire	Mid1:OPN	Early1:ALL	0.005	200	Yes	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.009	111	No	0
Mixed Fire	Mid1:CLS	Mid1:OPN	0.003	333	Yes	0

Wind or Weather or Stress	Mid1:CLS	Early1:ALL	0.003	333	Yes	0
Replacement Fire	Mid1:CLS	Early1:ALL	0.003	333	Yes	0
Surface Fire	Mid1:CLS	Mid1:CLS	0.006	167	No	0
Alternative Succession	Late1:OPN	Late1:CLS	1	1	Yes	20
Replacement Fire	Late1:OPN	Early1:ALL	0.003	333	Yes	0
Wind or Weather or Stress	Late1:OPN	Early1:ALL	0.006	167	Yes	0
Surface Fire	Late1:OPN	Late1:OPN	0.011	91	No	0
Mixed Fire	Late1:CLS	Late1:OPN	0.002	500	Yes	0
Replacement Fire	Late1:CLS	Early1:ALL	0.002	500	Yes	0
Wind or Weather or Stress	Late1:CLS	Early1:ALL	0.006	167	Yes	0
Surface Fire	Late1:CLS	Late1:CLS	0.008	125	No	0

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