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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