

13210

South-Central Interior Mesophytic Forest

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Forest and Woodland

Map Zones

49

Geographic Range

This BpS model represents the mixed mesophytic forests of the unglaciated Southern Interior Plateau in southern IL, corresponding to the Northern Shawnee Hills (71m) and Southern Shawnee Hills (71n) Level IV Ecoregions of Woods et al. (2006). The IL distribution of this BpS coincides with the Western Mesophytic Forest Region, Hill Section described by Braun (1950).

Biophysical Site Description

Mixed mesophytic forests occur on moist, topographically protected areas (e.g. coves, v-shaped valleys, north and east facing toe slopes) in the unglaciated Shawnee Hills region. On slopes it forms a mosaic with pyrogenic oak-hickory forests, where cove or mixed mesophytic forests are restricted to the most protected coves and oak-hickory occurs on the interfluvies. The dissected topography creates gradients in microclimate and soil moisture and fertility at the local (watershed) scale (Hutchins et al. 1976, Iverson et al. 1997, Morris and Boerner 1998). In the absence of frequent or catastrophic disturbance, these environmental gradients determine forest composition (Hutchins et al. 1976, Muller 1982, Iverson et al. 1997, Dyer 2001). These forests occupy the transition zone from the oak-hickory forest to the northern hardwood forest. They are among the most diverse in the United States, supporting over 30 canopy tree species. This model focuses on the mixed mesophytic forest as represented in MZ49.

NatureServe (2007) separates the South-Central Interior Mesophytic Forest from the Southern and Central Appalachian Cove Forest (1318), which is found in regions east of 1321, including portions of eastern Pennsylvania, eastern West Virginia, western Virginia, eastern Kentucky, eastern Tennessee, western North Carolina, and northern Georgia.

Vegetation Description

This BpS supports very high diversity of canopy species. In MZ49, characteristic trees include beech (*Fagus grandifolia*), yellow-poplar (*Liriodendron tulipifera*), American basswood (*Tilia americana* var. *heterophylla*), sugar maple (*Acer saccharum*), hickories (*Carya* spp.), red oak (*Quercus rubra*), white oak (*Quercus alba*), cucumber-tree (*Magnolia acuminata*), white ash (*Fraxinus americana*), black walnut (*Juglans nigra*), shagbark hickory (*Carya ovata*), red elm (*Ulmus rubra*) and black gum (*Nyssa sylvatica*) (Braun 1950, Braun 1961, Fike 1999, Muller 1982). American chestnut (*Castanea dentata*) and yellow buckeye (*Aesculus flava*), characteristic

of this BpS east of MZ49, were absent or local. In addition to these species, numerous other species are often present as scattered individuals in the canopy. This forest type developed primarily on mesic, sheltered landscape positions (e.g., lower slopes, coves, ravines) but also occurred on some dry-mesic slopes, where presumably fire was infrequent (Wade et al. 2000). In addition to slope and aspect, substrate base status impacts the distribution and abundance of canopy trees (Runkle and Whitney 1987). A preponderance of white oak may be related to colonization events associated with historically favorable climatic conditions (McCarthy et al. 2001).

Common subcanopy and shrub species may include paw-paw (*Asimina triloba*), bladdernut (*Staphylea trifolia*), redbud (*Cercis canadensis*), spicebush (*Lindera benzoin*), wild hydrangea (*Hydrangea arborescens*), flowering dogwood (*Cornus florida*), maple-leaved viburnum (*Viburnum acerifolium*), musclewood (*Carpinus caroliniana*), sassafras (*Sassafras albidum*) and witch-hazel (*Hamamelis virginiana*) (Braun 1950, Runkle and Whitney 1987, Fike 1999, McCarthy et al. 2001, McEwan et al. 2005).

The ground layer of this BpS is often lush and species-rich (Braun 1950, Fike 1999). Spring-flowering herbs are abundant, and are represented by large white trillium (*Trillium grandiflorum*), drooping trillium (*T. flexipes*), prairie trillium (*T. recurvatum*), yellow trout-lily (*Erythronium americanum*), wood phlox (*Phlox divaricata*), squirrel-corn (*Dicentra canadensis*), dutchman's-breeches (*D. cucullaria*), blue cohosh (*Caulophyllum thalictroides*), wood poppy (*Stylophorum diphyllum*), bloodroot (*Sanguinaria canadensis*), spring beauty (*Claytonia virginica*) and a variety of other species. Ferns are often well-represented (Braun 1950, Fike 1999, McEwan et al. 2005, Illinois DNR 2007, NatureServe 2007).

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
FAGR	<i>Fagus grandifolia</i>	American beech
LITU	<i>Liriodendron tulipifera</i>	Tuliptree
ACSA3	<i>Acer saccharum</i>	Sugar maple
TIAMH	<i>Tilia americana</i> var. <i>heterophylla</i>	American basswood
CARYA	<i>Carya</i>	Hickory
QURU	<i>Quercus rubra</i>	Northern red oak
QUAL	<i>Quercus alba</i>	White oak
FRAM2	<i>Fraxinus americana</i>	White ash

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

Disturbance Description

The mixed-mesophytic forest type is fire regime class III, surface fires with return intervals 30-100yrs+ (Wade et al. 2000). Mixed severity fires will occur approximately every 500yrs opening the canopy with increased mortality. This effect may also be achieved by recurrent, severe insect defoliations or droughts. Straight-line winds or microbursts may cause blow-downs on a scale of 1 to 100 acres. Stand replacement fires happen very infrequently. This BpS is susceptible to Gypsy Moth, but its effects are not included in this model since it is a recent invasive. Another prominent current issue is oak decline, but its impact on reference conditions is not known and oaks are not typically a dominant species in stands of this type.

NatureServe (2007) makes note that this system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration on a fine scale. Occasional extreme wind or ice events may disturb larger patches. Natural fire dynamics are not well-known and probably only occurred in years that were extremely dry. Fires may have occurred at moderate frequency but were probably usually low enough in intensity to have only limited effects. Most of the component species are among the less fire-tolerant in the region.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	715	32		
Moderate (Mixed)	816	28		
Low (Surface)	554	40		
All Fires	226	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

Mixed mesophytic forests occur more continuously on north and east facing toe slopes, and inter-finger with oak-hickory on side slopes up to the northern hardwood zone and higher elevations.

NatureServe (2007) notes that most individual patches are tens to sometimes a few hundred acres. Because it frequently occurs in mosaics with other systems, separation distance for occurrences has a strong effect on the size of occurrences. Complexes of thousands of acres of this system are possible.

Adjacency or Identification Concerns

The mapping of mixed mesophytic forests would likely focus on specific topographic positions, such as coves, valley bottoms (typically v-shaped and excluding broad u-shaped floodplains), lower north and east facing slopes (and sometimes west and south facing lower slopes where moisture permits); generally wet-mesic to mesic conditions on the landscape; rich fertile conditions/sites; and shaded topographic positions (Nowacki personal communication). On side slopes, mixed mesophytic forests inter-finger with oak-hickory forests, with mixed-mesophytic occurring in v-notches and coves (drainages) and oak-hickory on interfluvies.

Issues or Problems

Witness tree data (from early land surveys) and studies of old-growth forests suggest that mixed-oak forests were generally more abundant on the landscape than mixed-mesophytic forests prior to European settlement (Beatley 1959, McCarthy et al. 1987, Abrams et al. 1995, Dyer 2001, McCarthy et al. 2001, Rentch et al. 2003). The delineation of the 'cove' or 'mixed-mesophytic' forest type today is influenced by the absence of fire, deer herbivory, and non-native invasive species (plants, animals, insects and disease). The absence of fire is causing an expansion of some of the characteristic mesic taxa out of coves, potentially replacing previous oak-dominated vegetation on drier and more exposed sites than those typically associated with 'mesic' vegetation.

This model was developed to represent the mixed mesophytic forest type as expressed in MZ49.

Native Uncharacteristic Conditions

Uncharacteristic types (structure/composition/etc.) that may frequently occur today in this BpS include: non-native invasive species (plants, animals, insects, pathogens, etc.), deer herbivory (limiting species composition and structure), and absence of fire. The exotic tree *Ailanthus altissima* may dominate local canopy gaps, replacing *Liriodendron*.

Comments

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	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Herb	0.5-1.0	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Herb	>1.0	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Shrub	0-0.5	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Shrub	0.5-1.0	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Shrub	1.0-3.0	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Shrub	>3.0	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Tree	0-5	A	A	A	A	A	A	A	A	A	A
Tree	5-10	UN	UN	UN	UN	UN	UN	UN	B	B	B
Tree	10-25	UN	UN	UN	UN	UN	UN	UN	B	B	B
Tree	25-50	UN	UN	UN	UN	UN	C	C	C	C	C
Tree	>50	UN	UN	UN	UN	UN	C	C	C	C	C

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 3 Early Development 1 - All Structures

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
FAGR	<i>Fagus grandifolia</i>	American beech	Upper
LITU	<i>Liriodendron tulipifera</i>	Tuliptree	Upper
ACSA3	<i>Acer saccharum</i>	Sugar maple	Upper
QURU	<i>Quercus rubra</i>	Northern red oak	Upper

Description

Regenerating stands established after catastrophic disturbance, primarily wind and ice storms and less frequently by fire. Tree regeneration unfolds from a combination of stump and root sprouts

and the seed bank. This short-lived stage exists until canopy closure occurs and resource competition for growing space begins.

Maximum Tree Size Class

Sapling >4.5ft; <5"DBH

Class B 35 Mid Development 1 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
LITU	Liriodendron tulipifera	Tuliptree	Upper
QURU	Quercus rubra	Northern red oak	Upper
ACSA3	Acer saccharum	Sugar maple	Mid-Upper
FAGR	Fagus grandifolia	American beech	Mid-Upper

Description

Mid-seral closed overstory; stem exclusion stage. Intense competition begins after canopy closure and lasts until trees are large enough to form, upon their death, canopy gaps that are not captured by lateral growth of neighboring trees. This "released" growing space that is captured by tree and shrub regeneration. Liriodendron tulipifera may temporarily out compete some other slower-growing species.

Maximum Tree Size Class

Pole 5-9" DBH

Class C 62 Late Development 1 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
FAGR	Fagus grandifolia	American beech	Upper
ACSA3	Acer saccharum	Sugar maple	Upper
LITU	Liriodendron tulipifera	Tuliptree	Upper
QURU	Quercus rubra	Northern red oak	Middle

Description

Closed-canopy mixed-mesophytic forests that develop on mesic landscape positions and have dominant trees that are 100yrs+ of age. Dominant species include Fagus grandifolia, Acer saccharum, Liriodendron tulipifera, Tilia americana var. heterophylla (local), Prunus serotina, Quercus alba, and Quercus rubra.

Maximum Tree Size Class

Very Large >33"DBH

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:CLS	9
Mid1:CLS	10	Late1:CLS	99
Late1:CLS	100	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
Replacement Fire	Mid1:CLS	Early1:ALL	0.002	500	Yes	0
Wind or Weather or Stress	Mid1:CLS	Early1:ALL	0.003	333	Yes	0
Replacement Fire	Late1:CLS	Early1:ALL	0.001	1000	Yes	0
Mixed Fire	Late1:CLS	Mid1:CLS	0.002	500	Yes	0
Wind or Weather or Stress	Late1:CLS	Early1:ALL	0.002	500	Yes	0
Surface Fire	Late1:CLS	Late1:CLS	0.003	333	No	0

References

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau (Vinton and Jackson Counties, Ohio). Bulletin of the Ohio Biological Survey 1: 1-166 .

Braun, E.L. 1950. Deciduous forests of eastern North America. Blakiston Co., Philadelphia.

Braun, E.L. 1961. The woody plants of Ohio: Trees, shrubs, and woody climbers native, naturalized, and escaped. Hafner Publishing Company, New York. 362 pp.

Brown, James K.; Smith, Jane Kapler, eds. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol.2. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 257 pp.

Delcourt, P.A., H.R. Delcourt, C.R. Ison, W.E. Sharp, and K.J. Gremillion. 1998. Prehistoric human use of fire, the eastern agricultural complex, and Appalachian oak-chestnut forests: paleoecology of Cliff Palace Pond, Kentucky. American Antiquity 63: 263-278.

Dyer, J.M. 2001. Using witness trees to assess forest change in southeastern Ohio. Canadian Journal of Forest Research. 31: 1708-1718.

Fike, J. 1999. Terrestrial and palustrine plant communities of Pennsylvania. Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, Harrisburg, Pennsylvania.

Frost, C.C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. In Proceedings of the 20th Tall Timbers fire ecology conference--fire in ecosystem management: shifting the paradigm from suppression to prescription. Edited by Pruden, T.L. and L.A. Brennan. Tall Timbers Research Station, Tallahassee, FL. Pp. 70-81

Guyette, R.P., D.C. Dey, and M.C. Stambaugh. 2003. Fire and human history of a barren-forest mosaic in southern Indiana. *American Midland Naturalist* 149: 21-34.

Hutchins, R.B., R.L. Blevins, J.D. Hill, and E.H. White. 1976. The influence of soils and microclimate on vegetation of forested slopes in eastern Kentucky. *Soil Science* 121: 234-241.

Illinois Department of Natural Resources. 2007. Illinois Nature Preserves Directory. <<http://dnr.state.il.us/INPC/Npdir.htm>> Accessed 13 December 2007.

Iverson, L.R., M.E. Dale, C.T. Scott, and A. Prasad. 1997. A GIS-derived integrated moisture index to predict forest composition and productivity of Ohio forests (U.S.A.). *Landscape Ecology* 12: 331-348.

Küchler, A.W. 1964. Potential natural vegetation of the conterminous United States (map). Special Publication 36. American Geographic Society, New York.

McCarthy, B.C., C.J. Small, and D.L. Rubino. 2001. Composition, structure and dynamics of Dysart Woods, an old-growth mixed mesophytic forest of southeastern Ohio. *Forest Ecology and Management* 140: 193-213.

McEwan, R.W., R.D. Paratley, R.N. Muller, and C.L. Riccardi. 2005. The vascular flora of an old-growth mixed mesophytic forest in southeastern Kentucky. *Journal of the Torrey Botanical Society* 132: 618-627.

McNab, W.H., and Avers, P.E. 1994. Ecological subregions of the United States: section descriptions. USDA Forest Service Administrative Publication WO-WSA-5.

Mikan, C.J., D.A. Orwig, and M.D. Abrams. 1994. Age structure and successional dynamics of a presettlement-origin chestnut oak forest in the Pennsylvania Piedmont. *Bulletin of the Torrey Botanical Club* 121: 13-23.

Morris, S.J., and R.E.J. Boerner. 1998. Landscape patterns of nitrogen mineralization and nitrification in southern Ohio hardwood forests. *Landscape Ecology* 13: 215-224.

Muller, R.N. 1982. Vegetation patterns in the mixed mesophytic forest of eastern Kentucky. *Ecology* 63: 1901-1917.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of 10 February 2007.

Rentch, J.S., M.A. Fajvan, and R.R. Hicks Jr.. 2003. Spatial and temporal disturbance characteristics of oak-dominated old-growth stands in the central hardwood forest region. *Forest Science* 49: 778-789.

Runkle, J.R., and G.G. Whitney. 1987. Vegetation-site relationships in the Lake Katharine State Nature Preserve, Ohio: A Northern Outlier of the Mixed Mesophytic Forest. *Ohio Journal of Science* 87: 36-40.

Schmidt, K.M., J.P. Menakis, C.C. Hardy, W.J. Hann, D.L. Bunnell. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. USDA Forest Service GTR-RMRS-87.

Wade, D.D., B.L. Brock, P.H. Brose, J.B. Grace, G.A. Hoch, and W.A. Patterson III. 2000. Fire in eastern ecosystems. In *Wildland fire in ecosystems: effects of fire on flora*. Edited by Brown, J.K. and Smith, J.K. USDA Forest Service GTR-RMRS-42-vol. 2. pp. 53-96.