LANDFIRE Biophysical Setting Model

Biophysical Setting 5713180 **Southern and Central Appalachian Cove Forest**

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

General Information

Contributors (also see the Comments field) **Date** 8/15/2007

Modeler 1 Milo Pyne	milo_pyne@natureserve.org	**Reviewer**
Modeler 2		**Reviewer**
Modeler 3		**Reviewer**

Vegetation Type
Forest and Woodland

Map Zone
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Model Zone

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

Dominant Species*

FAGR	AEFL
LITU	QURU
ACSA3	QUAL
TIAMH	CADE12

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range

This BpS model represents the "cove forests" or mixed-mesophytic forests (including "Acid Coves" with Hemlock) of sheltered topographic positions in the Southern Blue Ridge and central Appalachian Mountains, ranging from northwestern GA through the southern Appalachians of the Carolinas and VA. It is found in an area that generally corresponds (in the south) with the Appalachian Oak region of Küchler (1964). To the northern end of its range, it includes parts of the Northern Hardwoods and Oak-Pine regions, and to the west it includes the higher elevation and more rugged parts of the Mixed Mesophytic region (e.g. Pine and Black Mountains in KY). This range is generally consistent with M221 of Keys et al. (1995).

Biophysical Site Description

Mixed mesophytic forests occur on moist, topographically protected areas (e.g. coves, v-shaped valleys, north and east facing toe slopes) within highly dissected hills and mountains. On slopes it forms a mosaic with pyrogenic oak-hickory forests, whereby cove or mixed mesophytic forests are restricted to the most protected coves and oak-hickory occurs on the interfluves. The dissected topography creates strong 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 containing more than 30 canopy tree species. This model focuses on the cove or mixed-mesophytic type in the Southern and Central Appalachian regions.

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NatureServe (2007) defines this system as not including rich, mesophytic "cove" forests of the Cumberland Plateau and Interior Low Plateau, even though some of these approach or exceed Appalachian examples in their species composition and or their "coveyness." This will be interpreted as variability within South-Central Interior Mesophytic Forest (CES202.887 -- BpS 1321).

Vegetation Description

A diverse closed-canopy forest with dominant species including beech (Fagus grandifolia) yellow-poplar (Liriodendron tulipifera), American basswood (Tilia americana var. heterophylla), sugar maple (Acer saccharum), yellow buckeye (Aesculus flava), red oak (Quercus rubra), white oak (Quercus alba) and formerly American chestnut (Castanea dentata) (Braun 1950, Muller 1982). This forest type developed primarily on mesic, sheltered landscapes positions (e.g., lower slopes, coves, ravines) but also occurred on some dry-mesic slopes, where presumably fire was infrequent (Wade et al. 2000).

NatureServe (2007) notes that Fraxinus americana, Aesculus flava, Betula lenta, Magnolia acuminata, Magnolia fraseri, Halesia tetraptera, Prunus serotina and Tsuga canadensis are the most frequent dominant canopy species. Canopies are generally very diverse, with all species potentially occurring in one 20x50-meter plot in rich cove areas.

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.

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 interfluves.

NatureServe (2007) makes the following comments regarding adjacent Ecological Systems: This system (BpS 1318) is usually bordered by Southern Appalachian Oak Forest (CES202.886 -- BpS 1315) in the Southern Blue Ridge. The border with adjacent systems is gradational. It may also contain small embedded patches of Southern Appalachian Montane Cliff and Talus (CES202.330) or other small-patch systems. Southern Appalachian Oak Forest (CES202.886 -- BpS 1315) occurs upslope from this system.

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In the southern Appalachians, the "richer" phase of Southern and Central Appalachian Cove Forest (CES202.373 this Bps, 1318) occurs downslope from the hemlock "phase" ("acidic cove forests") and tends to be more mesic and more species-rich than the hemlock-dominated areas.

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; the exotic grass Microstegium vimineum may dominate the herbaceous stratum of stands where it has become established.

Scale Description

Cove or Appalachian 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.

Issues/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 true 'cove' or 'mixed-mesophytic' forest type within the Southern and Central Appalachian region.

Comments

This model is based on the model R8MMHW (Mixed Mesophytic Hardwood) from the Rapid Assessment phase; that one replaced model R7MMHW from the Northeast model zone. The VDDT model for R8MMHW was adopted in its entirety and used to represent this BpS.

Modelers for R8MMHW include April Moore (amoore02@fs.fed.us), Greg Nowacki (gnowacki@fs.fed.us), and Aaron Burk (aburk@fs.fed.us). An additional modeler was Dan Yaussy (Dyaussy@fs.fed.us). This model is essentially identical to the model R7MMHW (Mixed Mesophytic Hardwood Forest) created for the Northeast region, with descriptive changes.

R8MMHW Model incorporates both the MMHF and MMPH FRCC models with additional description information and references. Further review is needed by the original modelers and others; particularly age class and species composition within those classes. Bruce Davenport developed the first mixed mesophytic hardwood forest model MMHF (4/23/05) which encompasses the range of Kuchler's mapping; the model focuses on the mixed mesophytic forest type where as the MMPH model incorporates both the mixed-oak

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and mixed-mesophytic forest types of this transitional PNVG.

No changes were made to the model during QA/QC, but additional information was provided by modelers and added, including brief mentions of Gypsy Moth and Oak Decline in the Disturbance Description, but these are assumed to be a more modern phenomena and are not specifically included in the model. Reviewers also suggested that these trees do not reach 600yrs in a single life span, but the implication of the model is that a late seral stage may maintain itself for 600yrs even though individual trees do not live that long. The reviewer also suggested that southern pine beetle could be a factor in the pine component in the early seral stages. However, pine species are not listed as dominants in any of the seral stages, so southern pine beetle should not have significant impact (nothing was added to the model).

Vegetation Classes

Class A 5%

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Indicator Species* and Canopy Position

FAGR	Upper
LITU	Upper
ACSA3	Upper
BEAL2	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Regenerating stands (class age = 0-9yrs) 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.

Class B 31%

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

LITU	Upper
BEAL2	Upper
ACSA3	Mid-Upper
FAGR	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	71 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Mid-seral closed overstory; stem exclusion stage (class age 10-99yrs). Intense competition begins after canopy closure (ca. 10-20yrs.) 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 and Betula alleghaniensis may temporarily out compete some other slower-growing species.

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Class C **10 %**

Late Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 10

Indicator Species* and Canopy Position

FAGR	Upper
ACSA3	Upper
LITU	Mid-Upper
BEAL2	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	50 %
Height	Tree 10.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 100-119yrs). Mature forest with gaps created by wind, ice storms, insect and disease, and to a lesser extent by fire, leading to "open" overstory conditions. Partial canopy disturbances from moderate-level wind events and ice storms are common and lead to multi-cohort stands. These events generally remove 25-50% of the canopy. Canopy would typically close after approximately 20yrs and move to class D. Dominant species include Fagus grandifolia, Acer saccharum, Liriodendron tulipifera, Castanea denata; also Tilia americana var. heterophylla, Aesculus flava, Tsuga canadensis, Prunus serotina, Quercus alba, and Quercus rubra.

Class D **54 %**

Late Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

FAGR	Upper
ACSA3	Upper
LITU	Upper
BEAL2	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	100 %
Height	Tree 10.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

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, Castanea denata; also Tilia americana var. heterophylla, Aesculus flava, Tsuga canadensis, Prunus serotina, Quercus alba, and Quercus rubra.

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

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Fire Regime Group: III**

Historical Fire Size (acres)

Avg 20
Min 1
Max 1000

Sources of Fire Regime Data

☑ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	561.2			0.00178	12
Mixed	738.8			0.00135	9
Surface	87.86			0.01138	78
All Fires	69			0.01452	

Fire Intervals (FI):
Fire interval is expressed in years for each fire severity class and for all types of fir combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inver 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 ☐ Native Grazing ☐ Other (optional 1)
☑ Wind/Weather/Stress ☐ Competition ☐ Other (optional 2)

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