LANDFIRE Biophysical Setting Model

Biophysical Setting 5713090 Southern Appalachian Northern Hardwood Forest

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

General Information

Contributors (also see the Comments field **Date** 9/17/2007

Modeler 1	Randy Swaty	rswaty@tnc.org	**Reviewer**	Carl Nordman	Carl_Nordman@natureserv.org
Modeler 2			**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type
Forest and Woodland

Map Zone
57

Model Zone

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

Dominant Species*
BEAL2 TSCA
QURU AEFL
ACSA3 LITU
FAGR

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
This system ranges from northwestern GA, western NC and eastern TN to VA and WV. The Northern Hardwood component also occurs in small part on Black Mt. in eastern KY.

Biophysical Site Description
High elevation sites in the Southern Appalachians. Generally occurring on all topographic positions above 1372m (4500ft) in the southern extent of the range, elevations may be considerably lower in the northern part of the range. At elevations greater than 1676m (5500ft) (975m in W. Virginia), spruce-fir forests become the predominant type, though the range of this sub-type is extremely limited within this zone. Soils are highly variable, ranging from deep mineral soils to well-developed boulderfields. Soils are most often rocky and acidic, with low base saturation. A thick organic soil layer is frequently present. Overall hydrology is mesic, ranging from wet in bogs, seeps, and the most protected sites to dry-mesic on some exposed upper slopes and ridges. Mesic conditions are maintained by high annual rainfall, frequent fog deposition, low temperatures, and heavy shading.

Vegetation Description
Co-dominant trees in Southern Appalachian Northern Hardwood Forests are sugar maple (Acer saccharum var. saccharum), American beech (Fagus grandifolia), yellow birch (Betula alleghaniensis) and yellow buckeye (Aesculus flava) in variable proportions. Overall floristic composition varies with specific site conditions, and two community types have been recognized by VANHP ecologists. The first is widespread throughout the higher elevations of the southern Virginia Blue Ridge and also represents outliers of the global type in the adjacent Ridge and Valley. Sugar maple and yellow buckeye are prominent in the overstory, along with yellow birch and beech. Black cherry (Prunus serotina var.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

serotina), white ash (Fraxinus americana) and northern red oak (Quercus rubra) are very minor overstory associates. Sapling sugar maple, striped maple (Acer pensylvanicum) and, more locally, mountain maple (Acer spicatum) are abundant understory species. Smooth blackberry (Rubus canadensis) is the only common shrub. Herb layers are moderately dense and usually contain nutrient-demanding species such as blue cohosh (Caulophyllum thalictroides) and wood nettle (Laportea canadensis) at low cover. However, the most abundant and constant herbs of this type are Appalachian white snakeroot (Ageratina altissima var. roanensis), southern lady fern (Athyrium filix-femina var. asplenioides), evergreen wood-fern (Dryopteris intermedia) and sweet white violet (Viola blanda var. blanda). This unit generally occurs on straight to concave slopes with west, north, or east aspects, and soils with slightly higher base status (particularly manganese levels) than those of the following.

Disturbance Description

This setting is characterized by stable, uneven aged forests. Canopy dynamics are primarily driven by single or multiple tree disturbances, encouraging gap-phase regeneration. Primary disturbance factors are wind events and ice storms. Extreme weather-driven events can also be important in larger scale disturbances. These are all more important than fire, although they predispose forests to fire during drought conditions. Fire Regime Group V. Destructive fires occurred rarely within this biophysical setting, usually occurring after catastrophic wind events, following periods of extreme drought. As much as 25% of this biophysical setting may be considered in a non-fire regime. When they occur, fires are severe and affect large patch sizes. Surface fire is extremely rare, at greater than 1000yr intervals, while replacement fire is more frequent at 300 to 1,000-year intervals. In spruce-fir dominated parts of this setting, replacement fires are severe and kill most trees and understory, removing most to all of the canopy and allowing pioneer species to emerge. Recent research indicates that on the most exposed sites, stand replacement fires in spruce-fir can result in a stable shrub-dominated community ("heath balds"). Mixed fires pass through the understory of the northern hardwood component, killing most smaller trees, leaving behind some large, well-established trees while creating canopy openings. Occurrence of fire is most frequent on sites where northern red oak dominates.

Adjacency or Identification Concerns

The northern hardwood component of this biophysical setting can have a nearly indistinguishable transition to the adjacent cove-hardwood community (mixed mesophytic). Montane oak forests can be found above 4500ft on very exposed slopes.

Native Uncharacteristic Conditions

Scale Description

Large scale. All landforms above 4500ft elevation are included.

Issues/Problems

In modern times other disturbances, especially logging, logging slash fires, balsam woolly adelgid (an exotic species), chestnut blight (exotic fungus), acid deposition and climate change are playing an important role.

Comments

LANDFIRE changes-Randy Swaty adopted R8SAHE (Southern Applachian High Elevation Forest) model from the Rapid Assessment and made these changes:

1. changed height and cover estimates so that classes would be mutually exclusive.
2. Changed class D to C pathways. In RA model there was a deterministic pathway from D to C leading to a situation where the ages didn't line up correctly. To work around this issue, an alternative succession

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

pathway going from D to C with a probability of 0.02 was added. This resulted in slightly different results than were obtained in the original model.

QA/QC changes: Added four references and additional info from modeler; changed Upper Layer Lifeform min Height from Shrub Med to Tree Regen with concurrence of original modeler. Peer reviewer suggested that more literature might be available, perhaps from Tall Timbers (note for LANDFIRE workshops).

Vegetation Classes

Class A 9 %

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

RUAL	Mid-Upper
RUCA16	Mid-Upper
PRPE2	Upper
BEAL2	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	90 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Typical gap replacement. Mostly single to multiple tree-sized gaps, but extreme weather-driven events can create larger scale openings. Stand replacement fires in northern hardwoods or spruce-fir also result in this class. Stand replacement in spruce-fir leads to a northern hardwood pathway. Rubus alleghaniensis, Rubus canadensis, Prunus pennsylvanica, Betula alleghaniensis, Quercus rubra, Fagus grandifolia. 0-24yrs.

Class B 18 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

ABFR	Upper
PIRU	Upper
FAGR	Upper
BEAL2	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Typical stand development following most single tree to stand replacement events. Betula alleghaniensis, Abies fraseri (or A. balsamea), Picea rubens, Prunus pennsylvanica, and Fagus grandifolia. Quercus rubra may be locally important on more exposed sites. 25-75yrs.

Class C 69 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

BEAL2	Upper
ABFR	Upper
PIRU	Upper
FAGR	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	81 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Dense, closed forest. Betula alleghaniensis, Abies fraseri (or A. balsamea), Picea rubens, Fagus grandifolia, Acer saccharum. Tsuga canadensis or Quercus rubra may be locally important. Well-developed deciduous shrub layer and dense herbaceous layer are frequent. 76yrs and on.

Class D 4 %

Late Development 2 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

QURU	Upper
BEAL2	Upper
RUAL	Low-Mid
PRPE2	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	60 %
Height	Tree 5.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

More open stands of northern hardwoods (especially red oak) resulting from rare mixed fires. Quercus rubra, Betula alleghaniensis, Fagus grandifolia, Rubus alleghaniensis, Prunus pennsylvanica. 76yrs and on. Note that this description does not include balds, although they may be subsumed in this type. Review Comments: Added Min TSD of 25 forAltSuccession (from 0). No significant change in outputs.

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:** V

Historical Fire Size (acres)

Avg 250
Min 1
Max 500

Sources of Fire Regime Data

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	499.3			0.00200	59
Mixed	709.1			0.00141	41
Surface					
All Fires	293			0.00342	

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

References

Brown, James K. and Smith, Jane Kapler, eds. 2000. Wildland fire in ecosystems:effects of fire on flora.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Gen. Tech. Rep. RMRS-GTR-42-vol.2. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 257 pp.

Konopik, E. 2005. Fire and northern hardwood forests in the southern Appalachians. Deborah Kennard, ed. http://www.forestryencyclopedia.net/Encyclopedia/Fire%20Science. > Fire Ecology > Northern Hardwoods.

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

Schafale, M.P. and Weakley, A.S. 1990. Classification of the natural communities of North Carolina: third approximation. North Carolina Natural Heritage Program.

White, R.D., K.D. Patterson, A. Weakley, C.J. Ulrey and J.Drake. 2003. Vegetation classification of Great Smoky Mountains National Park: Unpublished report submitted to BRD-NPS Vegetation Mapping Program. NatureServe: Durham, NC.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713150 Southern Appalachian Oak Forest

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

General Information

Contributors (also see the Comments field **Date** 9/24/2007

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

Vegetation Type
Forest and Woodland

Map Zone
57

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

Dominant Species*

QUPR2	CADE12
QURU	PIST
QUAL	QUCO2
QUVE	KALA

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
This system is restricted to the southern Appalachians, from approximately Roanoke, VA, south to northern GA. It is closely related to similar systems in adjacent regions (Piedmont, central Appalachians, Cumberlands), but is distinctive for its occurrence only at lower elevations in a region with much diversity in topography and elevation.

Biophysical Site Description
This system consists of predominantly dry-mesic (to dry) forests occurring on open and exposed topography at lower to mid-elevations in the Southern Blue Ridge and Southern Ridge and Valley ecoregions. This is the upland forest that characterizes much of the lower elevations of these areas. Substrates of stands included in this system can range from acidic to circumneutral or basic, and the vegetation varies accordingly. Typically, the vegetation consists of forests dominated by oaks, especially Quercus prinus, Quercus alba, Quercus rubra, and Quercus coccinea, with varying amounts of Carya spp., Acer rubrum, and other species. This system concept also includes many successional communities that have been impacted by logging or agriculture, such as types dominated by Liriodendron tulipifera, Pinus spp., and Robinia pseudoacacia. Bedrock may be of any type. Soils are usually deep residual soils, but are often rocky. Some shallow soils, colluvium, and other soils may be present locally within the group, but shallow soils tend to produce environments that are more extreme and have a larger component of various pine species.

Vegetation Description
Various species of oak (Quercus spp. are consistently present as major components of the tree stratum, along with hickories (Cary spp.) and other hardwoods. Historically American chestnut (Castanea dentata)

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

was a dominant or co-dominant in many of these communities until its virtual elimination by the chestnut blight fungus [Endothia (Cryphonectria) parasitica] during the early 1900's.

Typically, the vegetation seen today consists of forests dominated by oaks, especially white oak (Quercus alba) and northern red oak (Quercus rubra), and on drier sites chestnut oak (Quercus prinus), black oak (Quercus velutina) and scarlet oak (Quercus coccinea). Along with oaks are varying amounts of Hickory (Carya spp.), Red maple (Acer rubrum), Black gum (Nyssa sylvatica) and other species such as white pine (Pinus strobus) and white ash (Fraxinus americana). Currently subcanopies and shrub layers are usually well-developed. Some areas (usually on drier sites) now have dense evergreen ericaceous shrub layers of Mountain laurel (Kalmia latifolia), with Rhododendron (Rhododendron spp.) on more mesic sites. Some other areas have deciduous ericad layers, sometimes consisting of Blueberries (Vaccinium spp.) or Huckleberries (Gaylussacia spp.). This system concept also includes many successional communities that have been impacted by logging or agriculture, such as types dominated by Liriodendron tulipifera, Pinus spp. and Robinia pseudoacacia.

Herbs, forbs and ferns are sparse to moderate in density. Though often contiguous, patches of this system may be convoluted and interfingered with other systems, especially Mesophytic Cove Forests and Dry-Xeric Oak-Pine Forests. At the higher elevations it may grade into Northern Hardwood Forests. Small patches of other communities, such as rock outcrops and seepage wetlands, are sometimes embedded within this group.

This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration. Most oaks are long-lived with typical age of mortality ranging from 200 to 400yrs. Scarlet and black oaks are shorter lived with typical ages being approximately 50 to 100yrs while white oaks can live as long as 600yrs.

Extreme wind or ice storms occasionally create larger canopy openings. Virtually all examples have been strongly affected by introduction of the chestnut blight, which killed all of the American chestnut trees, eliminating it as a canopy dominant. The introduction, and now widespread establishment, of gypsy moth (Lymantria dispar) that favors oaks as food has also
affected these forests by causing widespread mortality of overstory trees depending on topographic position and precipitation amounts around defoliation events. Past logging, and now lack of fire, has affected most occurrences by changing canopies to an even-aged, or more even-aged, structure with an understory of shade tolerant but fire intolerant species such as white pine, red maple and striped maple (Acer pensylvanicum). Hickories are thought to have benefited greatly from the removal of American chestnut from the overstory, and their persistence and continued recruitment in contemporary oak-hickory forests may reflect fire exclusion in recent decades. This southern Appalachian system is characterized by the presence, in most occurrences, of plant species of southern Appalachian affinity, such as Magnolia fraseri, Gaylussacia ursina, Rhododendron calendulaceum, etc.

Disturbance Description

Fire Regime Group I. Fire occurred fairly frequently in pre-European settlement times. pre-settlement forest studies suggest fire return intervals of 7-26yrs (Schuler and McClain 2003, Ruffner and Abrams 2002, Shumway et al. 2001). These observations are consistent with previous research in the oak forests of Ohio, Maryland, and Missouri. Fires were usually low-intensity surface fires, with an occasional more intense fire that replaced patches of the overstory. The dominant species (oak and historically chestnut) are fairly fire-tolerant, making most fires non-catastrophic. If fires occurred during the spring "green-up" under very dry to drought conditions then patches of the overstory could be killed by basal injury

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

depending on aspect and fire behavior. Fire is important for favoring oak dominance over more mesophytic tree species such as red maple, beech, and blackgum. Fire also can be expected to have a moderate to strong effect on vegetation structure, producing a more open canopy and less dense understory and shrub layer than currently seen. Fire frequency and/or intensity is important for determining the boundary between this group and both the more mesic and the drier systems, and works in conjunction with aspect and exposure. Ice storm, wind, drought, and insect (gypsy moth) events are disturbances that also occur in this system at widely varying frequencies.

Adjacency or Identification Concerns

Stands of this BpS may be difficult to distinguish floristically (in relation to their canopies) from similar forests of adjacent regions; it is separated from those based primarily on (an admittedly arbitrary) biogeography.

Native Uncharacteristic Conditions

Scale Description

This is a matrix forest type over large parts of the geographic range, covering thousands of acres. This type is more-or-less endemic to the southern Appalachian mountains, where it may be inter-fingered with cove forests and more xeric oak-pine woodlands.

Issues/Problems

Some drier/xeric settings (e.g. narrow fire-prone ridges) may develop a substantial pine component of shortleaf, pitch and/or table mountain pine. Depending on location and elevation, these would be examples of Southern Appalachian Montane Pine Forest and Woodland (CES202.331; BpS 1352) or Southern Appalachian Low Elevation Pine Forest (CES202.332; BpS 1353).

Comments

This BpS model description and VDDT model were based upon the RA model R7APOK. The previous creaters/reviewers (of the RA starter model R7APOK Appalachian Dry-mesic Oak Forest) are Doug Wallner, Sue Gawler, Cecil Frost. Additional author was Steve Croy (scroy@fs.fed.us).

Original model Peer reviewed by Daniel Yaussy 3/30/05. The VDDT model was adjusted as per Daniel's comments. Peer reviewed by Michael S. Batcher, Ecologist, 04/22/05 and Daniel Yaussy, Supervisory Research Forester USDA Forest Service, 3/30/05.

Vegetation Classes

Class A **5 %**

Early Development 1 All Structure

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 6

Indicator Species* and Canopy Position

QUPR2	Upper
QUAL	Upper
QUVE	Upper
CADE12	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0 %	70 %
Height	Tree 0m	Tree 10m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 0-19yrs): Treefall gaps and small to medium patches 0-19yrs in age with saplings and small trees up to 20 cm (8 in) DBH. Potential canopy species (oaks) are typically mixed with subcanopy and shrub species and herbs. Most oaks are coppice grown from previously established and fire killed individuals with

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

some as seedlings from animal-buried acorns. Review Comments 11/07: Changed TSD for AltSuccession to 18 to follow LANDFIRE modeling rules [No significant impact on model outputs].

Class B **25 %**

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

QUPR2	Upper
QURU	Middle
CADE12	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 20-69yrs): Mid-seral closed. Old treefall gaps with closed canopy 20-69yrs in age. Trees ranging from 20-60cm (8-24in) DBH. Shade tolerant species in the understory.

Class C **35 %**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

QUPR2	Upper
QUAL	Upper
CADE12	Upper
KALA	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	60 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 20-69yrs): Mid-seral open woodland with an open midstory and canopy closure <60%. Age of 20-69yrs. Shrub/herbaceous cover patchy.

Class D **26 %**

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

QUPR2	Upper
QUAL	Upper
CADE12	Upper
KALA	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	80 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 70yrs+): Late- seral open. Forest with an open midstory and canopy closure 50-80%. Is 70yrs+. Shrub/herbaceous cover patchy.

Class E **9 %**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

QUPR2	Upper
CADE12	Upper
PIST	Middle
QURU	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	81 %	100 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Description

(Class age 70yrs+): Late- seral closed. Closed canopy forest with cover >80%. Trees 65yrs+ in. Midstory and understory closed with dense cover and stocking of shrubs and saplings.

Disturbances

Fire Regime Group:** I

Historical Fire Size (acres)

Avg 1000
Min
Max

Sources of Fire Regime Data

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	602.2	500	1000	0.00166	2
Mixed	139.3	200	500	0.00718	10
Surface	15.87	7	26	0.06302	88
All Fires	14			0.07186	

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

- [x] Insects/Disease
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

References

Abrams, M. D., D. A. Orwig, and J. Dockry. 1997. Dendroecology and successional. status of two contrasting old-growth oak forests in the Blue Ridge Mountains,. U.S.A. Canadian Journal of Forest. Research 27: 994-1002.

Abrams, M.D., D.A. Orwig and T.E. Demeo. 1995. Dendroecological analysis of successional dynamics for a presettlement-origin white-pine-mixed-oak forest in the southern Appalachians, USA. J, Eol. 83: 123-133.

Barnes, T.A. and D.H. VanLear. 1998. Prescribed fire effects on advance regeneration in mixed hardwood stands. Southern Jnl. Appl. For. 22: 138-142.

Brose, P., T. Schuler, D. Van Lear and John Berst. 2001. Bringing Fire Back: The Changing Regimes of the Appalachian Mixed Oak Forests. J. Forestry, November 2001: 30-35

Croy, Steve and Frost, Cecil. 2005. APOK FRCC Model. Available at www.frcc.gov.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 08 June 2007.

Nowacki, G.J. and M.D. Abrams. 1992. Community, edaphic, and historical analysis of mixed oak forests of thte Ridge and Valley Province in central Pennsylvania. Can. J. For. Res. 22: 790-800.

Ruffner, C.M. and M.D. Abrams. 2002. Dendrochronological investigation of disturbance history for a Native American site in Northwestern Pennsylvania. Jnl. Torrey Bot. Soc. 129: 251-260.

Ruffner, CM., A. Sluyter, M.D. Abams, C. Crothers, J. McLaugline and R. Kandare. 1997. Assessing

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Native American disturbances in mixed oak forests of the Allegheny Plateau. Pp. 96-103 in Communicating the Role of Silviculture in Managing the National Forests: Proceeding of the National Silviculture Workshop, May 19-22, 1997. USDA Northeast Forest Experiment Station General Technical Report NE-238.

Schuler, Thomas M.; McClain, W. Russ. 2003. Fire History of a Ridge and Valley Oak Forest. Res. Pap. NE-724. Newtown Square, PA: USDA Forest Service, Northeastern Research Station. 9 pp.

Shumway, D.L., M.D. Abrams and C.M. Ruffner. 2001. A 400-year history of fire and oak recruitment in an old-growth forest in western Maryland, USA. Can. J. For. Res. 31: 1437-1443.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713160 Southern Piedmont Mesic Forest

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

General Information

Contributors (also see the Comments field) **Date** 7/25/2007

Modeler 1	Kevin Harvell	kevin.harvell@ncmail.net	**Reviewer**	Milo Pyne	milo_pyne@natureserve.org
Modeler 2	Justin Shedd	jmshedd@ncsu.edu	**Reviewer**		
Modeler 3			**Reviewer**		

Vegetation Type
Forest and Woodland

Map Zone
57

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	ACLE
LITU	ACBA3
ACRU	QUAL
TIAMH	QURU

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
Ranges throughout the southern Piedmont, from VA to AL. In TNC ecoregion 52 (NatureServe 2007).

Biophysical Site Description
This system encompasses mixed deciduous hardwood or occasionally hardwood-pine forests of mesic sites in the Piedmont (TNC Ecoregion 52) of the southeastern United States. Most examples occur on lower or north-facing slopes where topography creates mesic moisture conditions. A mix of a small number of mesophytic trees is usually dominant, with Fagus grandifolia and Liriodendron tulipifera most prominent, Quercus alba and/or Quercus rubra may also be present or co-dominant. Both acidic and basic substrates are currently included in this concept, where shrub layers of mesophytic ericaceous shrubs may occur beneath an open tree canopy. Fire is naturally infrequent in this system, due to the slopes and moist conditions. If fire does penetrate, it is likely to be low in intensity but may have significant ecological effects (NatureServe 2007).

This forest type occurs on moist, topographically protected areas (e.g. coves, v-shaped valleys, N and E facing toe slopes) within highly dissected hills. On slopes it forms a mosaic with pyrogenic oak-hickory forests, whereby mesic forests are restricted to the most protected coves and oak-hickory occurs on the ridges. Elevations range from 400-1200ft? in the central portions of VA and NC. The dissected topography creates strong gradients in microclimate and soil moisture and fertility at the local (sub-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).

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Vegetation Description

A diverse closed-canopy forest with dominant species including a significant component of mesophytic species. Beech (Fagus grandifolia) is almost always abundant and is often strongly dominant. Red oak (Quercus rubra), yellow-poplar (Liriodendron tulipifera) and red maple (Acer rubrum) may be abundant (NatureServe 2007). In the western Piedmont Tsuga canadensis may be present (Schafale and Weakley 1990). Other canopy species include American basswood (Tilia americana var. heterophylla), sugar maples (Acer barbatum, Acer leucoderme), painted buckeye (Aesculus sylvatica) and white oak (Q. alba). 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).

A well-developed understory is usually present and may include Cornus florida, Ostrya virginiana, Acer rubrum and Ilex opaca (Schafale and Weakley 1990). Shrubs are generally sparse to moderate in density, except in heath bluffs and may include Vaccinium stamineum, Viburnum rafinesquianum, Evonumus americana and sometimes Kalmia latifolia (Schafale and Weakley 1990; NatureServe 2007). Herbs range from fairly dense in basic examples to sparse in acidic examples, and may be nearly absent in a few. The composition of all lower strata varies substantially with soil acidity (NatureServe 2007). Herb species may include Polystichum acrostichoides, Viola spp., Dichanthelium (Panicum) spp., Galium circaezans, Hexastylis arifolia, H. minor, Desmodium nudiflorum, Erythronium umbilicatum ssp. umbilicatum, Hepatica americana, Chamaelirium luteum, Epifagus virginiana, Tiarella cordifolia var. collina, Heuchera americana, Stellaria pubera, Podophyllum peltatum, Botrychium virginianum and Prenanthes serpentaria (Schafale and Weakley 1990).

Disturbance Description

The mesophytic forest type is fire regime class III, surface fires with return intervals 20-70yrs. Mixed severity fires may occur approximately every 100yrs depending on climatic conditions. This effect may also be achieved by recurrent, severe insect defoliations or droughts. Ice, straight-line winds or microbursts may cause blow-downs on a scale of 1 to 10 acres. Stand replacement fires happen very infrequently. Low intensity surface fires, whether natural or Native American ignited, would have maintained the more fire resistant American chestnut and Oak species.

NatureServe (2007) notes fire is naturally infrequent in this system, due to the slopes and moist conditions. If fire does penetrate, it is likely to be low in intensity and may not have significant ecological effects. These forests generally exist naturally as old-growth forests, with canopy dynamics dominated by gap phase regeneration. Most of the prevailing species are shade tolerant. Most are not very fire-tolerant.

Adjacency or Identification Concerns

Mapping mesophytic forests would likely focus on specific topographic positions, such as coves, valley bottoms typically v-shaped (excluding broad u-shaped floodplains), lower north and east facing slopes; sometimes west and south facing lower slopes where moisture permits; wet-mesic to mesic conditions on the landscape; rich fertile conditions/sites; shaded topographic positions. On side slopes, mesophytic forests form mosaic patterns with oak-hickory forests, with mesic forests occurring in v-notches and coves (drainages) and oak-hickory on ridges.

NatureServe (2007) notes this system is distinguished from Southern Piedmont Dry Oak-(Pine) Forest (CES202.339 -- BpS 1368) by the significant component of mesophytic tree species, particularly Fagus grandifolia, as well as by occurrence on mesic topographic sites. Some oaks may also be present.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

It is distinguished from Southern Piedmont Small Floodplain and Riparian Forest (CES202.323) and Southern Piedmont Large Floodplain Forest (CES202.324) by the absence of characteristic alluvial or bottomland species, along with upland position. This boundary can be somewhat difficult to place, as some alluvial species will occur upslope in basic soils, and some mesic forests will extend onto higher terraces in bottomlands (NatureServe 2007).

This system is closely related to Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242 -- BpS 1343) and in the northern part of the range may be very similar except for the geologic substrate. Farther south, there is a greater floristic difference between the two. This system is related to the cove forest systems of the southern Appalachians but lacks a number of species characteristic of those regions. These species are present in increasing numbers as one goes west in the Piedmont (NatureServe 2007).

The westernmost Piedmont has some examples of well-developed Southern and Central Appalachian Cove Forest (CES202.373 -- BpS 1318) in the more mountainous portions. Distinct subsets of this system, which could be recognized as different systems, are the basic/circumneutral and acidic examples, and also the shrubby heath bluffs (NatureServe 2007).

Native Uncharacteristic Conditions

Scale Description

This forest type occurs more continuously on north and east facing toe slopes, and interfinger with oak-hickory on side slopes.

NatureServe (2007) describes this system currently as a large-to small-patch system occurring as a regular part of the landscape mosaic in most of the Piedmont. It generally occurs as large to small patches, often in convoluted bodies following slopes in the dissected lands along streams and rivers. Contiguous convoluted patches or closely associated sets of patches may once have covered thousands of acres and perhaps could have been connected along miles of river bluffs. However, the effect of past fire on the extent of this system is uncertain, and it may have been confined to a more limited range of topography and to smaller, discontinuous patches than it now appears. Most remnants at present are several tens to hundreds of acres.

Issues/Problems

Delineating the mesic forest type today is influenced by the absence of fire, large herbivore species, and non-native invasive species (plants, animals, insects and disease). The absence of fire is causing an expansion of this vegetation out of coves and potentially replacing oak-dominated vegetation on some sites.

Comments

The Rapid Assessment model R8MMHW -- Mixed Mesophytic Hardwood was utilized as a starting point for creating the BpS model description and VDDT model for this BpS (1316). However, the R8MMHW model had only 4 seral stages and the VDDT model for 1316 has 5 stages.

The modelers for the R8MMHW included A. Moore; G. Nowacki; and A. Burk.

Vegetation Classes

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class A **5 %**

Early Development 1 All Structure

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

FAGR	Upper
LITU	Upper
ACLE	Mid-Upper
ACBA3	Mid-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 = 0-15yrs) 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 seedbank. This short-lived stage exists until canopy closure occurs and resource competition for growing space begins transitioning to class B. Stand replacement events would maintain class A.

These species may also be present as class indicator species.
Northern Red Oak
White Oak

Class B **15 %**

Mid Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

LITU	Upper
ACRU	Upper
ACLE	Mid-Upper
ACBA3	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	71 %	100 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Mid-seral closed overstory (class age 16-75yrs.); stem exclusion stage. Intense competition begins after canopy closure (ca. 16-75yrs.) and lasts until shade tolerant tree species (Fagus grandifolia) begin to replace fast growing shade intolerant species (Acer species).

Partial canopy disturbances from moderate-level wind events and ice storms (100yrs) are common and could lead to multi-cohort stands. These events generally remove 25-50% of the canopy. Stand Replacement events would revert back to class A. Landscape altering winds from hurricane or tornadic event (option 1) would occur every 500yrs, resulting in a progression to class C. Insect or disease occurring every 300yrs would impact only a localized stand, due to forest heterogeneity; resulting in progression to class C. With these disturbances or a frequent fire interval this class would progress to class C. If disturbances were excluded, the canopy would remain closed and progress to class E after approximately 60yrs.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class C 25 %

Mid Development 1 Open

Indicator Species* and Canopy Position

QURU	Upper
QUAL	Mid-Upper
LITU	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	70 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Description

Mid-seral open overstory (class age 16-75yrs). Historically maintained by low intensity surface fires, that suppressed less fire resistance trees. The seral stage continues until fire exclusion causes the forest to close or the forest matures, class D.

Mature forest with gaps created by wind, ice storms, insect and disease, and to a lesser extent by surface fire leading to "open" overstory conditions, class D, every 100yrs. Stand Replacement events would revert back to class A. Landscape altering winds from hurricane or tornadic event (option 1) would occur every 500yrs; resulting in progression to class C. Insect or disease occurring every 300yrs would impact only a localized stand, due to forest heterogeneity; maintaining the class in C. If disturbances were excluded then progression to class B would occur as an alternate succession.

Class D 15 %

Late Development 1 Open

Indicator Species* and Canopy Position

QUAL	Upper
QURU	Upper
LITU	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	70 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Please note that although C and D overlap in Structural Data, tree size class varies between the two classes.

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Description

Open-canopy mesophytic forests that develop on mesic landscape positions and have dominant trees that are 75yrs+ of age.

Dominant species include Quercus alba, and Quercus rubra also Fagus grandifolia, Acer barbatum, Liriodendron tulipifera, Tilia americana var. heterophylla, Aesculus sylvatica, Tsuga canadensis may be present in the western part of the range.

Partial canopy disturbances from moderate-level wind events and ice storms are common and could lead to multi-cohort stands. These disturbance events or a frequent surface fire interval would maintain itself, as class D. Stand Replacement events would revert back to class A. Landscape altering winds from hurricane or tornadic event (Option 1) would occur every 500yrs; resulting in progression to class A. Insect or disease occurring every 300yrs would impact only a localized stand, due to forest heterogeneity; maintaining the class in D. If disturbances were excluded (alternate succession), the canopy would close and progress to class E.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class E **40 %**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

LITU	Upper
ACRU	Upper
ACLE	Mid-Upper
ACBA3	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	71 %	100 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Please note that although B and E overlap in Structural Data, tree size class varies between the two classes.

Description

Late seral closed overstory (class age 75yrs+). Shade tolerant species (Fagus grandifolia) begin to dominate and replace fast growing shade intolerant species (Acer species).

Partial canopy disturbances from moderate-level wind events and ice storms are common and could lead to multi-cohort stands. These events generally remove 25-50% of the canopy. With these disturbances or a frequent surface fire interval this Class would move to Class D. Stand Replacement events would revert back to Class A. Landscape altering winds from hurricane or tornadic event (Option 1) would occur every 500yrs; resulting in progression to Class A. Insect or disease occurring every 300yrs would impact only a localized stand, due to forest heterogeneity; resulting in progression to Class D. If disturbances were excluded, the canopy would remain closed and maintain itself.

These species may also be present as Class Indicator species.
American beech
Northern Red Oak
White Oak
Basswood
Eastern Hemlock

Disturbances

Fire Regime Group:** **III**

Historical Fire Size (acres)

Avg 10
Min 1
Max 100

Sources of Fire Regime Data

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	526.3			0.0019	8
Mixed	344.8			0.0029	12
Surface	53.19	20	70	0.0188	80
All Fires	42			0.0236	

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) Tornadic/Hurricane Winds
- ☑ Wind/Weather/Stress
- ☐ Competition
- ☐ Other (optional 2)

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

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.

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., Delcourt, H.R., Ison, C.R., Sharp, W.E. and Gremillion, K.J. . 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.

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 Brennan, L.A. Tall Timbers Research Station, Tallahassee, FL. Pp. 70-81

Iverson, L.R., Dale, M.E., Scott, C.T. and Prasad, A. 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.

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

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 15 April 2007.

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

Schafale, M.P. and A.S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. N.C. Natural Heritage Program, Raleigh, N.C. 325 pp. http://www.ncnhp.org/Images/Other%20Publications/class.pdf. Accessed 22 August 2007.

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

Wade, D.D., Brock, B.L., Brose, P.H., Grace, J.B., Hoch, G.A. and Patterson III, W.A. 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.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713170 Allegheny-Cumberland Dry Oak Forest And Woodland

☐ *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 Jeff Sole	jsole@tnc.org	**Reviewer**	
Modeler 2 Dave Minney	dminney@tnc.gov	**Reviewer**	
Modeler 3 Alison Coons	acoons@fs.fed.us	**Reviewer**	

Vegetation Type
Forest and Woodland

Map Zone
57

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

Dominant Species*
QUAL ACRU
QUFA CAGL8
QUPR2 CAAL27
QUCO2 CADE12

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
This system occurs on the Allegheny, Piedmont, and Cumberland plateaus, and may be applicable to other forests in the Central Hardwoods Region dominated by oak species, predominantly Quercus alba. This system can also be found as small isolated patches in the Southern Blue Ridge (NatureServe 2007).

Biophysical Site Description
This system encompasses dry hardwood forests on predominantly acidic substrates in the Allegheny and Cumberland plateaus, and ridges in the Ridge and Valley. This system can also be found as small isolated patches in the Southern Blue Ridge. Its range is more or less consistent with the "Mixed Mesophytic Forest Region" of Braun (1950) and Greller (1988), although it is not a mesic forest type (NatureServe 2007).

Vegetation Description
These forests were typically dominated by Quercus alba, Quercus falcata, Quercus prinus, Quercus coccinea, with lesser amounts of Acer rubrum, Carya glabra and Carya alba. These occur in a variety of situations, most likely on nutrient-poor or acidic soils and, to a much lesser extent, on circumneutral soils. American chestnut (Castanea dentata) was once dominant or codominant in many of these forests and sprouts of C. dentata can often be found where it was formerly a common tree. Small inclusions of Pinus echinata and/or Pinus virginiana may occur, particularly adjacent to escarpments or following fire. In the absence of fire, Pinus strobus may invade some stands (NatureServe 2007).

Today, subcanopies and shrub layers are usually well-developed. Some areas (usually on drier sites) now have dense evergreen ericaceous shrub layers of mountain laurel (Kalmia latifolia), fetterbush (Pieris floribunda), or on more mesic sites rhododendron (Rhododendron spp.). Other areas have more open

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

shrub layers, sometimes consisting of blueberries (Vaccinium spp.) or huckleberries (Gaylussacia spp.). Herbs, forbs and ferns are usually sparse to moderate in density.

Disturbance Description

This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration. Most oaks are long-lived with typical age of mortality ranging from 200 to 400yrs. Scarlet and black oaks are shorter-lived with typical ages being approximately 50 to 100yrs, while white oaks can live as long as 600yrs. A mixed pine component would exist on poor soils on ridgetops. Extreme wind or ice storms occasionally create larger canopy openings.

The oak-hickory forest is predominantly Fire Regime I, characterized by low-severity surface fires. Historically, indigenous fires accounted for over 95% of the ignitions over these landscapes. Vegetation types varied based on fire frequency and intensity. Grasslands burned often (annually, biennially) and were probably associated with flat-to-slightly rolling terrain that effectively carried fire. These grasslands, deliberately maintained by Native Americans for hunting purposes, were probably scattered throughout the forest matrix. Oak-hickory grubs (tree-sprout and shrub thickets) and small areas of yellow pine occurred where fire frequency was a bit less, probably 3 to 9yrs. Grub conditions would also arise immediately after catastrophic burns that would top-kill tree-dominated communities.

Savannas and woodlands developed within a moderate burning regime, with fire return intervals also averaging every 3 to 9yrs. Closed-canopy oak-hickory forests would develop where fire return intervals stretched beyond 15yrs. Shade-tolerant, fire-sensitive maples (and associated late-successional trees) would regenerate and form understories beneath oak-hickory canopies when fire was excluded over several decades. With continued fire exclusion, maple and other late-successional species would gradually replace overstory oaks and hickories through gap capture (Sutherland and Hutchinson 2003). A mosaic of vegetation types comprised oak-hickory landscapes contingent on fire history (Cutter and Guyette 1994). In a recent study on fire history of a red oak stand in West Virginia it was found that fire intervals ranged from 7 to 32yrs from 1846 to 2002 with a median of approximately 16yrs, and prior to the fire control era ranged from 7 to 15yrs (Schuler and McClain, 2003). Schuler and McClain stated that these observations did not deviate significantly from previous research in the oak forests of Ohio, Maryland, and Missouri. -- the above description was taken from RA model R6OAHI -- Oak Hickory.

NatureServe (2007) notes that Native Americans played a critical role in the development and maintenance of oak-hickory landscapes through fire ignition, as lightning-strike ignitions were limited. Natives burned these landscapes for a variety of reasons. Fire encouraged open habitats which, in turn, increased food-producing plants (forbs, mast) and ungulate herbivores (meat). Mixed (maple-dominated) forests were relegated to those areas where fire was restricted, often associated with mesic coves, wetter depressions, and lee-sides of natural fire breaks (e.g., rivers and lakes). Prolonged lengths of time (100 to 150yrs) were needed for maple dominance to manifest.

Adjacency or Identification Concerns

Adjacent Ecological System Comments: The somewhat more mesic and/or more base-rich forests of the lower slopes of the Cumberlands and the lower slopes and valleys in the Ridge and Valley are covered by South-Central Interior Mesophytic Forest (CES202.887 -- BpS 1321). Southern Ridge and Valley / Cumberland Dry Calcareous Forest (CES202.457 -- BpS 1376)--is found in some similar landscapes as BpS 1317 -- Allegheny-Cumberland Dry Oak Forest and Woodland, but on more base-rich substrates, which usually correspond to different landform positions (NatureServe 2007).

Native Uncharacteristic Conditions

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

American Chestnut was once a dominant species in this type, but was reduced dramatically in the 1930s. Sprouts of Castanea dentata can often be found where it was formerly a common tree.

Scale Description

Pre-European oak-hickory forests covered hundreds of thousands of contiguous acres.

Issues/Problems

This type occurs across many coarse mapped Rapid Assessment PNVGs. Many FRCC models are redundant, overlap, or are similar.

Comments

NOTE: 2/26/09: As a result of final QC for LANDFIRE National by Jennifer Long the user-defined min and max fire return intervals for replacement and mixed severity fire were deleted because they were not consistent with the modeled fire return intervals for these fire severity types.

A majority of the descriptive information for this BpS came from the R6OAHI (Oak Hickory) model of the Rapid Assessment. C. Szell developed a VDDT model based on the Rapid Assessment R6OAHI (Oak Hickory) model which is where the modelers pulled most of their descriptive information. C. Szell updated the R6OAHI model since it violated some LANDFIRE rules.

Possible reviewers: Todd Hutchinson, thutchinson@fs.fed.us; Thomas Schuler, tschuler@fs.fed.us; Richard Guyette, guyetter@missouri.edu; Greg Nowacki, gnowacki.

Vegetation Classes

Class A **1 %**

Early Development 1 All Structure

Upper Layer Lifeform

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

Fuel Model 3

Indicator Species* and Canopy Position

ANGE	Upper
SCHIZ4	Upper
SONU2	Upper
QUAL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Herb 0m	Herb >1.1m
Tree Size Class	None	

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

The dominant layer lifeform is grass/herbaceous with a sparse overstory of oak or pine.

Description

(Class age 0-3yrs); Class A is grasslands/savanna maintained by frequently recurring fire (1-5yrs). These patches would typically be less than 100ac, but may have been up to 500 acres. Native Americans used these lands for hunting, and agriculture/native plant gathering. If fire is absent (deterministic transition in this case), tree seedlings and sprouts will establish and move the community to the mid-seral, closed stage (class B).

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class B 13 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 1

Indicator Species* and Canopy Position

QUAL	Upper
QURU	Upper
ANGE	Low-Mid
QUVE	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	30 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 4-19yrs); this is an early tree regeneration (root and stump sprouts) phase; fire frequency is about 3-9yrs. Any area that does not burn frequently is probably too moist and will be populated by mixed-mesophytic tree species. Class B needs to have some surface fire to remove the more mesic (ACRU, ACSA, LITU, FAGR) seedlings and saplings from the understory and remove some of the oaks and hickories as well. Otherwise, you can not get to the open woodland / savanna stages (class C). Change after review: These communities will move to the late-seral closed, mixed mesophytic class (class E).

Areas that receive frequent surface fires will be populated by fire-adapted species such as oaks and hickories. These fires will top-kill seedlings and sprouts and a proportion of the saplings. These communities will develop into the mid-seral, open (class C) oak-hickory forest class. Occasional fires of high severity will top-kill all trees moving the community back to the early-seral class (class A). Review Changes: Surface Fire in class B retains pixels in class B-no change in probability. Succession for class B is to class C (which means surface fire did occur). If no Surface Fire occurs, the AltSuccession is to class E (late seral closed) for 1% of the landscape. Impact of these changes on the landscape are minor: Original Model: 1,5,35,50,9; New Model: 2,10,35,45,8.

Class C 32 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

QUAL	Upper
QURU	Upper
QUVE	Upper
QUCO2	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	60 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 20yrs+); this class is defined as the mid-seral open oak-hickory savannas and woodlands with a fire return interval of 5-15yrs. The canopy closure is less than 60%. This community quite commonly experiences frequent surface fires. If fire is absent from this community for an extended period, the canopy will become less open, moving the community into the late-seral, closed canopy (60-100%), oak-hickory forest (class D).

An occasional replacement fire will move this community back to a mid-seral, closed early tree regeneration phase (class B).

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class D 47 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

QUAL	Upper
QURU	Upper
QUCO2	Upper
QUVE	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	80 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 20yrs+); Class D is defined as a late seral closed canopy oak-hickory forest. Open understories of oak seedlings exist. Stand replacement fires in late-succession open class types are rare (200-year interval) and will result in return to a mid-succession closed class B. Mixed fire has a return interval of approximately 66yrs and will send the system to a mid-succession open class C. Surfaces fires occur every ten years and result in maintaining the late-succession open forest type. If the late-succession open forest type persists for 70yrs without any type of fire, it will convert to a late-succession mixed mesophytic closed forest type. This conversion is a result of species shift from dominant oaks to dominant maple, tulip tree, and beech, which do not support fire as readily.

Class E 7 %

Late Development 2 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

ACRU	Upper
ACSA3	Upper
LIRIO	Upper
FAGR	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	81 %	100 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class age = 20yrs+; Mixed (maple) forests develop during the absence of fire. Dense understories of shade-tolerant species develop. Age class equals 20yrs+. Replacement fires are very rare, occurring every 700yrs, and will revert the system to a mid-succession closed class B. Wind and weather stress events (150-year interval) will result in gap formation and a decline to mid-succession closed class B. Surface fire (20-year interval) will result in the system remaining in the current class type.

Disturbances

Fire Regime Group:** I

Historical Fire Size (acres)

Avg 100
Min 10
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	55.53			0.01801	15
Mixed	129.6			0.00772	6
Surface	10.62	2	25	0.09414	79
All Fires	8			0.11987	

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.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Additional Disturbances Modeled

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

References

Braun, E.L., 1950. Deciduous forests of eastern North America. Hafner Publishing Company, New York, NY.

Cutter, B.E. and R.P. Guyette, 1994. Fire history of an oak-hickory ridge top in the Missouri Ozarks. American Midland Naturalist 132: 393-398.

Greller, A. M., 1988. Deciduous forest. Pages 288-316 in: M. G. Barbour and W. D. Billings, editors. North American terrestrial vegetation. Cambridge University Press, New York.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 08 June 2007.

Schuler, T.M., McClain, W.R., 2003. Fire history of a ridge and valley oak forest. Newtown Square, PA, USDA Forest Service, Northeastern Forest Service.

Sutherland, E.K., Hutchinson, T.F., Yaussy, D.A., 2003. Introduction, study area description, and experimental design (Chapter 1). Newtown Square, PA, USDA Forest Service, Northeastern Research Station.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

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
57

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.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

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.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

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

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

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.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

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

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Fire Regime Group:** III

Historical Fire Size (acres)

Avg 20
Min 1
Max 1000

Sources of Fire Regime Data

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Additional Disturbances Modeled

- [x] Insects/Disease
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

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.

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.

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., Delcourt, H.R., Ison, C.R., Sharp, W.E. and Gremillion, K.J. 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.

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 Brennan, L.A. Tall Timbers Research Station, Tallahassee, FL. Pp. 70-81

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

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

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

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

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

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

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

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

Morris, S.J. and Boerner, R.E.J. 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.

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

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

Wade, D.D., Brock, B.L., Brose, P.H., Grace, J.B., Hoch, G.A. and Patterson III, W.A. 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.

Personal Communications

Davenport, B. February 15, 2005.
Nowacki, Greg. 2005. LANDFIRE Northeast modeling workshop.
Williams, C.E. 2004. Landtype mapping challenge-cost share agreement.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713200 Central and Southern Appalachian Montane Oak 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	Gregory Nowacki	gnowacki@fs.fed.us	**Reviewer**
Modeler 2	Dan Yaussy	dyaussy@fs.fed.us	**Reviewer**
Modeler 3			**Reviewer**

Vegetation Type
Forest and Woodland

Map Zone
57

Model Zone

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

Dominant Species*
QURU ACPE
QUPR2 ACRU
BELE TIAM
CADE12

General Model Sources
☐ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
This system is found at higher elevations, mostly between 610-1372m (2000-4500ft), of the central and southern Appalachian Mountains, VA and WV.

NatureServe (2007) notes the system from VA and WV to GA. In KY, this system is restricted to the Cumberland Mountains in the extreme southeastern corner of that state.

Biophysical Site Description
Characterized as rocky, talus slopes that occur at high elevations. The excessively rocky surface limits the growing space for plants (in between rocks), and as such, these are open woodland systems with sparse shrub and grass understories and an abundance of rocks.

These high-elevation deciduous forests occur on exposed sites mostly between 915 and 1372m (3000-4500ft) elevation and includes high ridgelines and exposed upper slopes. The soils are thin, nutrient-poor, and acidic (NatureServe 2007).

Vegetation Description
These are open woodland talus fields primarily comprised of often-stunted, overstory Quercus rubra, and, more rarely, Quercus alba, Quercus prinus, Betula lenta and/or alleghaniensis are also present. There are lesser amounts of Tilia americana, Acer rubrum and other Quercus spp. Acer spicatum and pensylvanicum are small trees that form a sparse mid-story. Mountain laurel, blueberry and various grasses occur in between rocks.

NatureServe (2007) also notes that the understory is usually dominated by ericaceous shrubs, but some

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

communities are either dominated by graminoid species or ferns. Only rarely are the communities dominated by other herbs. Ilex montana and Rhododendron prinophyllum are characteristic shrubs. Castanea dentata sprouts are also common today, but the importance of chestnut in these forests has been dramatically altered by chestnut blight.

Disturbance Description

Stand-replacing rock slides occur periodically due to the high amount of surface rock and severe slopes. At these high elevations, ice storms occur frequently and pose the greatest risk to old, craggy trees. Surface burning is restricted due to the excessive surface rock and discontinuous fuels/litter. Due to prevailing open conditions, trees are relatively wind firm.

NatureServe (2007) notes that the communities of this system inhabit some of the most inhospitable parts of the Appalachians. Their occurrence on exposed high ridges means they are subject to frequent ice and wind storms in the summer and high winds throughout the year. This probably explains the forests stunted appearance. In addition, lightning-caused fires may create ground fires that change the understory composition and inhibit some ericaceous shrub species in some areas. Despite the high elevation, chestnut had been a fairly substantial component of this system and can still be seen as rotting stumps in the forest.

Adjacency or Identification Concerns

The system according to NatureServe (2007) generally occurs as a transition between Southern Appalachian Oak Forest (CES202.886 -- BpS 1315) and the more mesic Southern Appalachian Northern Hardwood Forest (CES202.029 -- BpS 1309) that occurs on less-exposed ridgetops and protected upper slopes.

Below 915-1220m (3000-4000ft), this BpS (Central and Southern Appalachian Montane Oak Forest) can grade into Southern Appalachian Oak Forest (CES202.886).

Above 1372m (4500ft) elevation and below spruce-fir communities, Central and Southern Appalachian Montane Oak Forest tends to be replaced by the Southern Appalachian Northern Hardwood Forest (CES202.029) since the habitat on most slopes at this elevation tends to favor those species adapted to a more mesic environment.

Native Uncharacteristic Conditions

Scale Description

These areas can range from small rock slides (one acre) to larger rock dominated surfaces along mountain slides (100s of acres).

NatureServe (2007 notes this BpS is usually smaller than 10ac but can be larger if the slope is broadly convex on the upper exposed slopes.

Issues/Problems

Despite the high elevation, chestnut had been a fairly substantial component of this system and can still be seen as rotting stumps in the forest.

Comments

NOTE: 2/26/09: As a result of final QC for LANDFIRE National by Jennifer Long the min height in class A was changed from “Herb 0m” to “Tree 0m,” the max height in class A was changed from “Shrub 1.0m” to “Tree 5m” and the min height in class B was changed from “Shrub 1.1m” to “Tree 0m” because

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

according to LANDFIRE National rules height should only be designated for the upper-layer lifeform, which in all cases was "Tree."

Suggested reviewer: Marc Abrams, U of Pennsylvania

Vegetation Classes

Class A 2 %

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 1

Indicator Species* and Canopy Position

QURU	All
QUPR2	All
BETUL	All
ACPE	All

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	20 %
Height	Tree 0m	Tree 5m
Tree Size Class	Seedling <4.5ft	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Post-catastrophic system. Barren rocky soil. Grasses and seedling/sprouts resulting from rock slides. Fires or drought would reset this stage.

Class B 21 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

QURU	Upper
QUPR2	Upper
BETUL	Upper
ACPE	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	60 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Developing after lack of disturbance in stage A or ice or wind disturbance in stage C. Review Comments 11/07: to follow LANDFIRE modeling rules, I added the probabilities of 2 wind/weather/stress disturbances with the same destination [No impact on the model outputs].

Class C 77 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

QURU	Upper
QUPR2	Upper
BETUL	Upper
ACPE	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	70 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Limited growing spaces and infertility ensure that these stands maintain their open structure into maturity. Open-grown trees are short and gnarly. Fire is limited by discontinuous fuels and occurs occasionally. Other disturbances include ice and wind storms and periodic drought. Review Comments 11/07: to follow LANDFIRE modeling rules, I added the probabilities of 2 wind/weather/stress disturbances with the same destination [No impact on the model outputs].

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

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:** I

Historical Fire Size (acres)

Avg 50
Min 5
Max 100

Fire Intervals

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement					
Mixed					
Surface	12.51			0.07991	100
All Fires	13			0.07993	

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.

Sources of Fire Regime Data

☐ Literature
☐ Local Data
☑ Expert Estimate

Additional Disturbances Modeled

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

References

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 08 June 2007.

Woods, A. J., J. M. Omernik, W. H. Martin, G. J. Pond, W. M. Andrews, S. M. Call, J. A. Comstock and D. D. Taylor. 2002. Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey, Reston, VA. (map scale 1:1,000,000)

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713210 South-Central Interior Mesophytic Forest

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

General Information

Contributors (also see the Comments field) **Date**

Modeler 1	Kim J. Brown	treebiology@gmail.com	**Reviewer**
Modeler 2	Carlen Emanuel	cemanuel@tnc.org	**Reviewer**
Modeler 3			**Reviewer**

Vegetation Type
Forest and Woodland

Map Zone
57

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	QURU
LITU	JUNI
ACSA3	CADE12
TIAMH	TSCA

General Model Sources

☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range

The mixed-mesophytic forest region (Küchler 1964) is located in two of Bailey's ecoregion sections (McNab and Avers 1994). It includes the southern portion of the Southern Unglaciated Allegheny Plateau Section (southeastern Ohio, western WV, northeastern KY). It also covers the Northern Cumberland Plateau Section (eastern KY and east-central TN; and southern Blue Ridge ecoregion, and a very small portion in northeast AL and northwest GA). There are also scattered occurrences in northwestern and central Pennsylvania (C.E. Williams, G. Nowacki personal communication). In the southern limits of this forest type, one might find this more restricted to more northerly aspects.

These high-diversity, predominately deciduous forests occur on deep and enriched soils (in some cases due to, or enhanced by, the presence of limestone or related base-rich geology), usually in somewhat protected landscape positions such as coves or lower slopes. The core distribution of this system lies in the Cumberland and Allegheny plateaus, extending into the adjacent southern Ridge and Valley and portions of the Interior Low Plateau where it is located entirely south of the glacial boundary.

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 mixed mesophytic forests are restricted to the most protected coves and oak-hickory occurs on the interfluves. These Plateaus are mature and dissected, most of the landscape consisting of high hills and narrow valleys. Elevations range from 650 to 1,300 ft. in the Allegheny Plateau and from 1,270 to 2,000 ft. in the Cumberland Plateau (McNab and Avers 1994). 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

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

(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 type lies west of the Appalachians and transitions from the more northern sugar maple-beech-birch forest in northern West Virginia, southwestern Pennsylvania (lesser extent in northwestern and central PA), and southern Ohio southward down the Allegheny Mountains, across the Allegheny Plateau including all of the Cumberland Plateau, and into northern Alabama where it transitions to the oak-hickory-pine type of the Southern Mixed Hardwood Forest (Brown et al. 2000). Two major and distinct forest types within this BpS are typically recognized: mixed-oak and mixed-mesophytic. This model focuses on the mixed-mesophytic type. This model crosswalks to NatureServe Terrestrial Ecological Classification, under the heading Deciduous Forest Woodland.

CES 202.596 Central and Southern Appalachian Montane Forest
CES 203.477 East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest
CES 202.887 South-Central Interior Mesophytic Forest
CES 202.373 Southern and Central Appalachian Cove Forest
CES 202.886 Southern Appalachian Oak Forest
CES 202.342 Southern Piedmont Mesic Forest

Vegetation Description

A diverse closed-canopy forest with dominant species including: beech (Fagus grandifolia), tulip-poplar (Liriodendron tulipifera), American basswood (Tilia americana var. heterophylla), sugar maple (Acer saccharum), yellow buckeye (Aesculus flava), Magnolia acuminata and Juglans nigra, red oak (Quercus rubra), white oak (Q. alba) and formerly American chestnut (Castanea dentata) (Braun 1950, Muller 1982). The oak component tends to grade from white oaks in the southern areas to red and black oaks in the northern geographic range of this forest type. Tsuga canadensis may be a minor component of some stands. Trees may grow very large in undisturbed areas. In the northern areas, both white (Fraxinus americana) and green ash (Fraxinus pennsylvanica) can be up to 10-15% of forest type (C. Emanuel, personal communication). 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).

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. Due to the mesic nature of these forests, stand replacement fires happen very infrequently. Ice storm damage is a more common disturbance than fire in this system, and yet ice storm frequency directly feeds into fuel loading at these sites. The oaks found within this forest type are susceptible to Gypsy Moth, but these 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.

Adjacency or Identification Concerns

Mapping mixed mesophytic forests would likely focus on specific topographic positions, such as coves, valley bottoms typically v-shaped (excluding broad u-shaped floodplains), lower north and east facing slopes; sometimes west and south facing lower slopes where moisture permits; wet-mesic to mesic conditions on the landscape; rich fertile conditions/sites; shaded topographic positions (Nowacki personal

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

communication). On side slopes, mixed mesophytic forest interbraid with oak-hickory forests, with mixed-mesophytic occurring in v-notches and coves (drainages) and oak-hickory on interfluves.

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 historical fire suppression.

This forest type grades into Northeastern Interior Dry-Mesic Oak Forest (1303) - where this forest type grades into northern sites when soils are drier (shallower soils, sandier parent material), and as elevation is increased. In contrast the South-Central Interior Mesophytic Forest (1320) has gentler slopes with soils featuring a higher water holding capacity.

Native Uncharacteristic Conditions

Tree of Heaven (Ailanthus altissima) is a significant invader in these sites, due to its ability to persist in fairly intact canopy as well as its high water demand (K Brown, personal communication).

Scale Description

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

Issues/Problems

Though Küchler (1964) mapped and described this region as mixed-mesophytic, witness tree data (from early land surveys) and studies of old-growth forests suggest that mixed-oak forests were more abundant than mixed-mesophytic forests in many areas prior to European settlement (Beatley 1959, McCarthy et al. 1987, Abrams et al. 1995, Dyer 2001, McCarthy et al. 2001, Rentch et al. 2003). Delineating the potential boundaries of 'mixed-mesophytic' forest type today should recognize that this boundary is influenced by human management interactions: historic logging and high-grading, the absence of fire, deer populations (herbivory), and non-native invasive species (plants, animals, insects and disease).

Comments

K. Brown and C. Emanuel based the model description for 571321 -- South-Central Interior Mesophytic Forest off of the Rapid Assessment model R8MMHW -- Mixed Mesophytic Hardwood.

Previous modelers for the Rapid Assessment Mixed Mesophytic Hardwood (R8MMHW) model (9/30/2005) included:
April Moore, amoore02@fs.fed.us
Greg Nowacki, gnowacki@fs.fed.us
Aaron Burk, aburk@fs.fed.us

The following notes pertain to the Rapid Assessment Model R8MMHW as written by Moore, Nowacki, and Burk:
This model replaces the model R7MMHW from the Northeast model zone.

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

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

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 and mixed-mesophytic forest types of this transitional PNVG.

No changes were made to the model during QA/QC, but additional information on 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 more modern phenomena and are not specifically included in the model. Reviewer also suggested that these tree 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 2%

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Indicator Species* and Canopy Position

FRAM2	Upper
LITU	Upper
ULAM	Upper
BELE	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Tree 0m	Tree 10m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 0-9yrs): Regenerating stands (age = 0-9yrs) established after catastrophic disturbance, primarily wind and ice storms and infrequently by fire. Tree regeneration unfolds from a combination of stump and root sprouts and the seedbank. This short-lived stage exists until canopy closure occurs and resource competition for growing space begins.

Class B 8%

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

LITU	Upper
FRAM2	Upper
ACSA3	Lower
FAGR	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	75 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 10-60yrs): Mid-seral closed overstory; stem exclusion stage. Although canopy closure occurs at approximately ten years of age, intense competition between canopy dominants begins after the stand is approximately 20yrs old. Large gaps are not common, as mortality from tree suppression tends to result from crown overtopping (not gap formation). Red oak is found as seedlings in the understory (and is found as a canopy dominant in later successional stages). These stands will remain in this self-thinning, closed canopy condition until approximately 60yrs old.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class C 5 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

FAGR	Upper
ACSA3	Upper
LITU	Upper
fram2	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	70 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 61-119yrs): Mature forest with gaps created by wind, ice storms, insect and disease, and to a lesser extent by fire leading to small gap openings. Low intensity fires may occur, but more severe fires with the potential for gap formation and alteration of canopy structure are much less frequent. 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 10yrs and progress to class E (late successional forest with complex canopy structure).

Class D 3 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

FAGR	Upper
ACSA3	Upper
LITU	Upper
QURU	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	71 %	100 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 61-119yrs): Closed-canopy, mature, mixed-mesophytic forests that develop on mesic landscape positions, on deep, rich soils, and the presence of limestone and/or base-rich geologic parent material. Dominant trees are 100yrs+ of age. Dominant species include Fagus grandifolia, Acer saccharum, Liriodendron tulipifera, Quercus rubra, also Tilia americana va. Heterophylla, Aesculus flava, Tsuga canadensis.

Class E 82 %

Late Development 2 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

ACSA3	Upper
LITU	Upper
FAGR	Upper
QURU	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	71 %	100 %
Height	Tree 50.1m	Tree >50.1m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 120 yrs+): Late successional stands, >120yrs old, which feature: some individual trees nearing maximum age and size for their species, multiple canopy strata, gaps, regeneration of multiple age and size classes, and coarse woody debris (standing and down) (Davis 1993). Dominant species: Fagus grandifolia, Acer saccharum, Liriodendron tulipifera, Quercus rubra. Fire is infrequent with low intensity (e.g., surface fires during droughts). Canopy structure is maintained by wind, ice, insect and disease events – and the scale of disturbance is dominated by gap dynamics (Davis 1993).

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Disturbances

Fire Regime Group:** III

Historical Fire Size (acres)

Avg 20
Min 1
Max 1000

Sources of Fire Regime Data

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	833.5			0.0012	9
Mixed	569.8			0.00176	14
Surface	102			0.00981	77
All Fires	78			0.01276	

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

- [x] Insects/Disease
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

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.

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.

Davis, M.B (ed.) 1993. Eastern Old-Growth Forests: Prospects For Rediscovery And Recovery (Paperback) ISBN: 155963409X

Delcourt, P.A., Delcourt, H.R., Ison, C.R., Sharp, W.E. and Gremillion, K.J. 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.

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 Brennan, L.A. Tall Timbers Research Station, Tallahassee, FL. Pp. 70-81

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

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

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Iverson, L.R., Dale, M.E., Scott, C.T. and Prasad, A. 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., Small, C.J. and Rubino, D.L. 2001. Composition, structure and dynamics of Dysart Woods, an old-growth mixed mesophytic forest of southeastern Ohio. Forest Ecology and Management 140: 193-213.

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

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

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

Wade, D.D., Brock, B.L., Brose, P.H., Grace, J.B., Hoch, G.A. and Patterson III, W.A. 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.

Personal Communications

Davenport, B. February 15, 2005.
Nowacki, Greg. 2005. LANDFIRE Northeast modeling workshop.
Williams, C.E. 2004. Landtype mapping challenge-cost share agreement.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713500 Central and Southern Appalachian Spruce-Fir 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	KellyAnn F Gorman	kellyann_gorman@nps.gov	**Reviewer**
Modeler 2	Carlen Emanuel	cemanuel@tnc.org	**Reviewer**
Modeler 3			**Reviewer**

Vegetation Type
Forest and Woodland

Map Zone
57

Model Zone

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

Dominant Species*

PIRU	FAGR
BEAL2	TSCA
ABFR	ACSA3
ABBA	QURU

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
This system ranges from western NC and eastern TN (Balsam Mountains and Great Smokey Mountains) to the mountains of VA and WV. The northern hardwood component also occurs in a small part on Black Mountain in eastern KY.

Biophysical Site Description
This system consists of forests in the highest elevation zone of the Southern Blue Ridge and parts of the central Appalachians. Generally occurring on all topographic positions above 1676m (5500ft), up to the highest peaks, but can be found as low as 975m (3200ft) at the northern range in West Virginia (NatureServe 2007). Occurs in the Central Appalachian Broadleaf-Coniferous and Forest Meadow ecological provinces, and the Northern Ridge and Valley and Blue Ridge Mountain ecological sections (others also likely). Generally, site conditions are poor, with short frost-free seasons.

Soils are highly variable, ranging from deep mineral soils to well-developed boulder fields. Soils may be saturated for long periods from a combination of precipitation and seepage. Any kind of bedrock may be present, but most sites have erosion-resistant felsic igneous or metamorphic rocks (NatureServe 2007).Toward the southern end of the range, soils are most often rocky and acidic, with low base saturation; toward the northern end, sites tend to be characterized by shallow, poorly developed, easily eroded soils on steep slopes. A thick organic soil layer is frequently present.

Overall hydrology is mesic, ranging from wet in bogs, seeps, and the most protected sites to dry-mesic on some exposed upper slopes and ridges. Mesic conditions and generally a cool, wet climate are maintained by high annual rainfall, frequent fog deposition, low temperatures, and heavy shading. This type would

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

have dominated the landscape throughout with inclusions of other forest types in wetter spots, or at higher elevations.

Vegetation Description

Vegetation consists primarily of forests dominated by Picea rubens, Abies fraseri, or Abies balsamea, occasionally by Sorbus americana. Betula alleghaniensis, Tsuga canadensis and Quercus rubra are the only other locally common canopy species (NatureServe 2007).

This system produces stable, uneven-aged forest in various combinations of dense evergreen, broadleaf and mixed forest with canopy dynamics dominated by gap-phase regeneration on a fine scale. The highest elevations support nearly pure expanses of Fraser fir (Abies fraseri) and/or red spruce (Picea rubens); balsam fir (Abies balsamea) replaces Fraser fir in Virginia and West Virginia north of Mount Rogers. Associated species in these upper elevations include yellow birch (Betula alleghaniensis), mountain ash (Sorbus americana), pin cherry (Prunus pensylvanica), mountain maple (Acer spicatum), hobble bush (Viburnum alnifolium) and bearberry (Vaccinium erthrocarpum). American beech (Fagus grandifolia) may occur in pure stands at a small scale. With decreasing elevations, typical northern hardwood species (B. alleghaniensis, F. grandifolia and Aesculus flava) mix with P. rubens. As P. rubens drops out, various combinations of B. alleghaniensis, F. grandifolia, A. flava, Acer saccharum and Quercus rubra dominate. Eastern hemlock (Tsuga canadensis) may be locally important.

A well-developed deciduous shrub layer is common, and a dense evergreen shrub layer (or shrub-dominated community - "heath balds") can develop on more exposed sites. A few associations have dense shrub layers of Rhododendron catawbiense, Rhododendron maximum, or Vaccinium erythrocarpum. The lower strata is often dense, and diversity may be high with many Southern Appalachian endemics; dominated by mosses, ferns, or forbs.

Disturbance Description

This setting is characterized by stable, uneven aged forests with canopy dynamics driven primarily by single or multiple tree disturbances resulting in gap-phase regeneration. Natural disturbances include lightning fire, debris avalanches, wind events, and ice storms (White and Pickett 1985, Nicholas and Zedaker 1989). Occasional extreme wind events disturb larger patches on the most exposed slopes. Strong winds, extreme cold, rime ice, and other extreme weather are periodically important (NatureServe 2007).

Weather disturbances, including windthrow, insect attack (especially bark beetle, spruce budworm, fungi), and ice storms, occur at intervals of 100 to 200yrs and are the primary disturbances. Rare extreme weather events are also important large-scale disturbances. Insect outbreaks, including bark beetles, spruce budworm (20-yr intervals), and butt rot (a fungi; predisposes stands 50-70yrs old to windthrow), are also important disturbances (USDAFS 1973). These disturbances likely pre-dispose the forest to fire during drought conditions.

Fire Regime Group V. Surface fire is extremely rare, at greater than 1,000yr intervals, while replacement fire is more frequent, at 300 to 1,000-year intervals, and affects large patch sizes. As much as 25% of this biophysical setting may be considered a non-fire regime. In spruce-fir dominated parts of this setting, replacement fires are severe and kill most trees and understory, removing most if not all of the canopy and allowing pioneer species to emerge. Recent research indicates that on the most exposed sites, stand replacement fires in spruce-fir can result in a stable shrub-dominated community ("heath balds"). Mixed fires pass through the understory of the northern hardwood component, killing most of the smaller trees, leaving behind some large, well-established trees while creating canopy openings. Occurrence of fire is

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

most frequent on sites where northern red oak dominates.

Lumbering + fire and/ or fire alone will scarify soils and pin cherry dominates badly burned areas. Yellow birch invades stands and becomes dominant later. Invasion by spruce – fir slow on badly burned sites. Windthrow produces dense fir seedlings if fir overstory is mature (SAF 1980)

Adjacency or Identification Concerns

The northern hardwood component of this biophysical setting can have a nearly indistinguishable transition to the adjacent cove-hardwood community (mixed mesophytic). Montane oak forests can be found above 4500' on very exposed slopes.

NatureServe (2007) also notes the following regarding identification of this system: Bordered by Southern Appalachian Northern Hardwood Forest (CES202.029 -- BpS 1309) or Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593 -- BpS 1370) at lower elevations. It may contain embedded small patches of Southern Appalachian Rocky Summit (CES202.327) and Southern Appalachian Grass and Shrub Bald (CES202.294 -- BpS 1414).

This system is similar to the spruce-fir systems of the northern Appalachians and the boreal forests but differs in having less frequent natural fire, having southern seasonal dynamics (shorter winters, less extreme cold temperatures, lack of long summer days), lacking a history of glaciation, and in a flora and fauna that has southern Appalachian endemics and lacks some characteristic northern species.

High-elevation spruce-fir in West Virginia is placed in this system because its location well below the glacial boundary and presence of species of more southern affinity (e.g., Rhododendron maximum and Vaccinium erythrocarpum) differentiate it from the northern Appalachian system, despite having Abies balsamea rather than Abies fraseri. Abies balsamea appears to be infrequent in this system, for example being restricted to wet areas in West Virginia.

Native Uncharacteristic Conditions

Climate change may be resulting in warmer conditions in the Southern Appalachians, restricting the occurrence of this type to less area than it occupied prior to Euro-American settlement.

Earlier, unnatural fires fueled by logging slash turned large expanses of this system into grass-shrub-hardwood scrub that has not recovered to conifer dominance after 90yrs. (NatureServe 2007).

Anthropogenic disturbances and stresses, beyond the effects of logging, have had major effects on dynamics in these systems in recent decades. An introduced insect, the balsam woolly adelgid (Adelges piceae), has killed almost all of the mature Abies fraseri. Saplings are not susceptible, resulting in many dense stands of young trees. It is unclear if these stands will establish seedlings before they too are killed (NatureServe 2007).

Stress caused by concentrated air pollutants on the mountain tops has been suggested as a cause of observed growth declines in Picea rubens (NatureServe 2007).

Scale Description

Primarily fine-scale (single- and multiple-tree) canopy gap dynamics.

Generally covers most of the landscape in the limited areas at the tops of the highest mountain ranges. Natural patches range from hundreds to thousands of acres. A couple remnant patches of thousands of

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

acres remain, while other intact patches are dozens of acres embedded in landscapes of degraded spruce-fir systems (NatureServe 2007).

Issues/Problems

In modern times other disturbances, especially logging, logging slash fires, balsam woolly adelgid (an exotic species), chestnut blight (exotic fungus), acid deposition, and climate change are playing an important role. Because of the declining area of this community, any large windthrow events can be locally significant. The balsam wooly adelgid has decimated the endemic Fraser fir populations throughout its range. Although regeneration of Fraser fir is plentiful, the continued presence of the adelgid ensures a lack of recruitment to mature size. Additionally, there has been a large increase in downed woody debris resulting from extensive tree mortality.

Comments

The model is based on R8SAHE -- Southern Appalachian High-Elevation Forest, combined with R7SESF -- Southeastern Red Spruce - Fraser Fir. Although R7SESF has only three boxes in its model, these modelers felt that R8SAHE better represented the Southern Appalachian / MZ61 area better than R7SESF.

R8SAHE modelers: Rob Klein (rob_klein@nps.gov)
R7SESF modelers: KellyAnn Gorman (kellyann_gorman@nps.gov), Erin Small (esmall@fs.fed.us), Sue Gawler (sue_gawler@natureserve.org)

It is possible that human caused (anthropogenic) fires are more important than natural fires. Further, it is presumed that some openings observed by settlers involved Indian activity (J. Dan Pittillo, comment on R7SESF).

Referenced Documents are copied from R8SAHE and R7SESF, with two new references.

Recommended Reviewers: Rob Klein (rob_klein@nps.gov); J. Dan Pitillo, W. Carolina University, Cullowhee, NC; Erin Small, USFS (esmall@fs.fed.us); Sue Gawler (sue_gawler@natureserve.org); Carl Nordman (carl_nordman@natureserve.org).

Vegetation Classes

Class A 18 %

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

BEAL2	Upper
PRPE2	Upper
RUAL	Mid-Upper
ACSP2	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	80 %
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 0-35yrs); typical young gap-replacement species dominated by pioneer hardwoods. Mostly single to multiple tree-sized gaps, but extreme weather-driven and/or fire events can create larger openings. Betula alleghaniensis, Rubus alleghaniensis, Rubus canadensis, Prunus pennsylvanica, Quercus rubra, Fagus grandifolia, Acer spicatum.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class B 13 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Indicator Species* and Canopy Position

BEAL2	Upper
PIRU	Mid-Upper
ABFR	Mid-Upper
ABBA	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	71 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 36-65yrs); typical stand development following most single-tree to stand-replacement events. Middle-aged stand with hardwoods still dominating the upper canopy but conifers increasing in dominance in the middle stories. Betula alleghaniensis, Abies fraseri or A. balsamea, Picea rubens, Prunus pennsylvanica, and Fagus grandifolia. Quercus rubra may be locally important on more exposed sites. Fuel model may be 8 in stands lacking a significant conifer component.

Pin cherry dies out of these sites at ca ~ 23 – 40yrs of age and is replaced by dense seedlings of spruce and fir. Windthrow disturbance reduces the canopy of pin cherry and yellow birch. Gaps are colonized by conifer seedlings

---

Class C 11 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

BEAL2	Upper
ABFR	Mid-Upper
PIRU	Mid-Upper
ABBA	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	70 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 36-65yrs); more open stands dominated by northern hardwoods, especially red oak, resulting from rare mixed fires. This class occasionally occurs in the southern parts of the range, but is not characteristic further north in Virginia or West Virginia. In the absence of disturbance, this will class succeed to a closed stand (class D). That is, over time, in the presence of a seed source, spruce and fir will re-occur.

Class D 58 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Indicator Species* and Canopy Position

BEAL2	Upper
PIRU	Upper
ABFR	All
ABBA	All

Structure Data (for upper layer lifeform)

	Min	Max
Cover	81 %	100 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 66yrs+); dense, closed, stable, mature forest dominated by spruce and/or fir, although pioneer hardwoods are still the tallest trees at the beginning of this stage. The pioneer hardwoods (Yellow birch, sorbus, sugar maple, and buckeye would be other hardwoods), starting with birch, begin to drop out as stands

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

age, although shade-tolerant hardwoods may continue to regenerate and comprise a significant component of the understory. Betula alleghaniensis, Abies fraseri or A. balsamea, Picea rubens, Fagus grandifolia, Acer saccharum. Tsuga canadensis or Quercus rubra may be locally important. A well-developed deciduous shrub layer and dense herbaceous layer may occur. Stands may be stable in this stage for long periods of time (500yrs+, until a major disturbance occurs), although individual trees are not this long-lived.

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:** **V**

Historical Fire Size (acres)

Avg
Min
Max

Sources of Fire Regime Data

☑ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals	*Avg FI*	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	830.7			0.00120	93
Mixed	11990			8.3E-05	6
Surface					
All Fires	776			0.0013	

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)

References

Brown, James K. and 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.

Eyre, F. H. ed. 1980. Forest Cover Types of the United States and Canada. Society of American Foresters, Washington, D.C. 148 pp.

Konopik, E. 2005. Fire and northern hardwood forests in the southern Appalachians. Deborah Kennard, ed. Http://www.forestryencyclopedia.net/Encyclopedia/ Fire%20Science > Fire Ecology > Northern Hardwoods.

Kuchler, A.W. 1964. Southeastern spruce-fir forest (Picea-Abies). #97 In: Manual to accompany the map Potential Natural Vegetation of the United States. New York, NY: The American Geographical Society. 156.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Loehle, Craig. 1988. Tree life histories: the roles of defenses. Canadian Journal of Forest Research 18: 209-222.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 08 June 2007.

Nicholas, N. S. and S. M. Zedaker. 1989. Ice damage in spruce-fir forests of the Black Mountains, North Carolina. Canadian Journal of Forest Research 19: 1487-1491.

Schafale, M.P. and Weakley, A.S. 1990. Classification of the natural communities of North Carolina: third approximation. North Carolina Natural Heritage Program.

Schmidt, Kirsten M, Menakis, James P., Hardy, Colin C., Hann, Wendel J., Bunnell, David L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 pp. + CD.

Southern Appalachian Man and the Biosphere. 1996. The Southern Appalachian Assessment Terrestrial Technical Report. Report 5 of 5. Atlanta, GA: USDA Forest Service, Southern Region.

US Department of Agriculture, Forest Service. 1965. Silvics of forest trees of the United States. Agricultural handbook 271. Washington, DC: US Department of Agriculture, Forest Service, Division of Timber Management Research.

US Department of Agriculture, Forest Service. 1973. Silvicultural systems for the major forest systems of the United States. Pp 71-72 in: Agricultural Handbook 445. Washington, DC: US Department of Agriculture, Forest Service, Division of Timber Management Research.

US Department of Agriculture, Forest Service, Southern Region. 1997. Montane and allied spruce and spruce-fir forest old-growth forest community. Pp. 100-102 in: Guidance for conserving and restoring old-growth forest communities in National Forests in the Southern Region: Report of the Region 8 Old-Growth Team. Forestry Report R8-FR 62. Atlanta, GA: USDA Forest Service, Southern Region. 120 pp.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online 12 February 2004]. Available: http://www.fs.fed.us/database/feis/.

White, P. S. and S. T. A. Pickett. 1985. Natural disturbance and patch dynamics: An introduction. Pages 3-13 in: P. S. White and S. T. A. Pickett, editors. The ecology of natural disturbance and patch dynamics. Academic Press, Orlando, FL.

White, P.S., E.R. Buckner, J.D. Pittillo and C.V. Cogbill. 1993, High-elevation forests: spruce-fir forests, northern hardwoods forests, and associated communities. In Martin, W.H., S.G. Boyce and A.C. Echternact. Biodiversity of the southeastern United Atates. John Wiley & Sons, Inc. Pp. 305-337.

White, R.D., K.D. Patterson, A. Weakley, C.J. Ulrey and J.Drake. 2003. Vegetation classification of Great Smoky Mountains National Park: Unpublished report submitted to BRD-NPS Vegetation Mapping Program. NatureServe: Durham, NC.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713520 Southern Appalachian Montane Pine Forest and Woodland

☐ *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	Steve Croy		**Reviewer**	Wanda SanJule	wsanjule@tnc.org
Modeler 2	Margit Bucher	mbucher@tnc.org	**Reviewer**	Charles Lafon	clafon@geog.tamu.edu
Modeler 3	Sam Lindblom	slindblom@tnc.org	**Reviewer**		

Vegetation Type
Forest and Woodland

Map Zone
57

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

Dominant Species*
PIPU5 GAYLU
PIRI VACCI
QUPR2 QUIL
QUCO2

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
Blue Ridge Mountains of TN, NC, and VA (including extreme northeast GA and northwest SC). Mountains of the Ridge and Valley in VA and WV. Western extent is along the KY-VA border on Pine Mtn.

There may also be isolated examples occurring on ridges or monadnocks like Pine Mountain (MZ54 GA), Kings Mountain (MZ59 NC), Pilot Mountain and Hanging Rock in NC.

Biophysical Site Description
Occurs on xeric to dry sites at moderate to upper elevations between 1000-4000ft. Typically described as "ridgetop communities" this community occupies the driest and most fire-prone of sites. Sites are typically located on convex, south to west facets of steep spur ridges, narrow rocky crests, and cliff tops. They occur at elevations from below 300m (1,000 ft) to more than 1,200m (4,000 ft) on various substrates, but most commonly on acidic, sedimentary and metasedimentary substrates, e.g ., sandstone, quartzite, and shale. A few stands occur on Piedmont monadnocks and foothills. Soils are very infertile, shallow, and droughty. Thick, poorly decomposed duff layers, along with dead wood and inflammable shrubs, contribute to a strongly fire-prone habitat.

Vegetation Description
Overstory pine species dominate with up to 70% species specific (e.g. Pinus pungens or Pinus rigida, sometimes with Pinus virginiana or rarely Pinus echinata codominant (NatureServe 2007)) . Chestnut oak (Q. prinus) and Scarlet oak (Quercus coccinea) and other pines may also be in overstories. Midstories, when present, may include mountain laurel (Kalmia latifolia), blackgum (Nyssa sylvatica), red maple

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

(Acer rubrum), sourwood (Oxydendrum arboretum), black locust (Robinia pseudoacacia) and sprouts of American chestnut (Castanea dentate). Understories can include hobblebush (Viburnum lantanoides), blueberries (Vaccinium spp.), huckleberries (Gaylussacia spp.), Galax urceolata, sedges and other herbaceous species.

Short-statured table-mountain pine (Pinus pungens) and pitch pine (Pinus rigida) are usually the dominants forming an open overstory, often with co-dominant chestnut oak (Quercus prinus). Less important tree associates include scarlet oak (Quercus coccinea), Virginia pine (Pinus virginiana) and sassafras (Sassafras albidum). Except in the Piedmont stands, bear oak (Quercus ilicifolia) is characteristically abundant in the shrub layer, along with various ericaceous species. Colonial shrubs usually pre-empt available microhabitats for most herbaceous species, but bracken fern (Pteridium aquilinum var. latiusculum) and turkey-beard (Xerophyllum asphodeloides) are often competitive enough to achieve significant cover.

The globally rare variable sedge (Carex polymorpha), the state-rare northern pine snake (Pituophis melanoleucus melanoleucus), several rare moths and all bear oak feeders are locally associated with these woodlands. More common and conspicuous animals often found in these dry, rocky, semi-open habitats include the northern fence lizard (Sceloporus undulatus hyacinthinus) and the five-lined skink (Eumeces fasciatus).

Disturbance Description

Periodic fire is an important ecological process that provides opportunities for regeneration of both pines and less competitive herbaceous species, while setting back successional encroachment of potential overstory species (especially chestnut oak, black gum, red maple, and white). On cliffs and other very rocky sites, the vegetation is self-perpetuating due to extreme edaphic conditions. Fire reduction and the native insect pest, southern pine beetle (Dendroctonus frontalis) are the most serious threats to communities of this group, although historically, pine beetle-induced mortality followed by stand-replacing fire was a principal mechanism for pine regeneration.

NatureServe (2007) notes that if the pines are lost, the distinction between this system and Southern Appalachian Oak Forest (CES202.886 -- BpS1315) or Central Appalachian Pine-Oak Rocky Woodland (CES202.600 -- BpS1377) becomes blurred.

Fire Regime Group I with relatively common surface fires (2-9yrs) and rarer mixed (160yrs ?) and replacement (100yrs ?) fires. Non-fire disturbances that resulted in stand alteration (rarely replacement) included mortality from insects (biotic) and wind-weather related events (abiotic) e.g., windstorm and ice.

In the absence of frequent fire, encroachment by oak (and other tree/shrub species) occurs leading to dense and overcrowded stands with little, if any, pine regeneration. In these encroached stands the older remaining stressed pines are more likely predisposed to insects.

Adjacency or Identification Concerns

This system is similar to and should be compared with BpS 1377 -- Central Appalachian Pine-Oak Rocky Woodland (CES202.600). Distinctions between these systems and BpS 1353 -- Southern Appalachian Low-Elevation Pine Forest (CES202.332) and 1354 -- North-Central Appalachian Pine Barrens (CES202.590) should also be reviewed.

A subset of northern and central Appalachian Pine-Oak / Heath communities that occurs on exposed, high-elevation summits of sedimentary ridges are sometimes referred to as montane or Appalachian “pine

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

barrens." Although these communities are fire-influenced, the vegetation retains a dwarfed, shrub land (less than six meters [20ft] tall) physiognomy even during long absences of fire due to extremely shallow, xeric soils and constant exposure to severe winds and ice. Only one occurrence of such a "pine barren" is documented in Virginia, covering about 60 ha (150 ac) on Warm Springs Mountain (Bath County), at elevations between 1100-1200m (3600-4000ft). Larger examples occur in nearby West Virginia at elevations from 1200-1375m (4000-4500ft) on the summit of North Fork Mountain (Pendleton County). The singular Virginia occurrence is characterized by dense, nearly impenetrable thickets of Catawba rhododendron (Rhododendron catawbiense), bear oak (Quercus ilicifolia), mountain-laurel (Kalmia latifolia), black huckleberry (Gaylussacia baccata), and late lowbush blueberry (Vaccinium angustifolium), with scattered emergent (but still shrub-sized) pitch pines (Pinus rigida). The average height of the barrens vegetation varies from knee-high in years following intense burns to about five meters (16ft). Compositionally and environmentally, the Central Appalachian "pine barrens" can be considered part of the Pine – Oak / Heath Woodlands ecological group, but more study is needed to determine whether the Virginia stand represents a distinct community type.

NatureServe (2007) makes the following comments regarding adjacent ecological systems: This system is almost always bordered and intermixed with Southern Appalachian Oak Forest (CES202.886 -- BpS 1315) or (in the northern half of its range) by Central Appalachian Pine-Oak Rocky Woodland (CES202.600 -- BpS 1377).

The distinctions are made more difficult by the suppression of fire and subsequent invasion of less fire-tolerant species such as Acer rubrum and Nyssa sylvatica. Generally speaking, communities with a heavy component of pine (at least 25 or 50% of canopy) are categorized as Southern Appalachian Montane Pine Forest and Woodland (CES202.331-- BpS 1352), whereas communities with a much smaller component of pines are considered Southern Appalachian Oak Forest (CES202.886 -- BpS 1315) or Central Appalachian Pine-Oak Rocky Woodland (CES202.600 -- BpS 1377)). Central Appalachian Pine-Oak Rocky Woodland (CES202.600) is distinguished by a mixed or deciduous canopy and absence of Pinus pungens. At the highest elevations that this system is seen, it may intergrade with Southern Appalachian Grass and Shrub Bald (CES202.294 -- BpS 1414).

Stands with Pinus echinata present are generally accommodated by Southern Appalachian Low-Elevation Pine Forest (CES202.332 -- BpS 1353). The relationship between these two systems may need further clarification. Southern Appalachian Low-Elevation Pine Forest (CES202.332) is distinguished by occurrence as small patches on the most extreme topography, as well as by the species of pines dominating. However, Pinus echinata may codominate in Southern Appalachian Low-Elevation Pine Forest (CES202.332) at times.

Sites that would support Southern Appalachian Montane Pine Forest and Woodland (CES202.331-- BpS 1352) under a natural fire regime, but which have lost the pines by logging, southern pine beetle or senescence in the absence of fire, should probably be regarded as degraded examples of this system.

Native Uncharacteristic Conditions

Now present and increasingly abundant red maple (Acer rubrum),white pine (Pinus strobes), blackgum (Nyssa sylvatica), oaks (Quercus spp), and mountain laurel (Kalmia latifolia) has been typified as the "native invasive" in pine forests and woodlands. Their abundance in these systems measured in both stem density and basal area has grown considerably due to fire suppression and the marked increase in fire return interval. The increasing abundance of oak, white pine, red maple, and black gum in this type can be attributed to fire suppression. In the absence of frequent fire, encroachment by oak (and other tree/shrub

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

species) occurs leading to dense and overcrowded stands with little, if any, pine regeneration. In these encroached stands the older remaining stressed pines are more likely predisposed to insects.

In many stands, mountain laurel seems to be a greater problem than any of the tree species (Lafon, pers. comm.).

Sites that would support Southern Appalachian Montane Pine Forest and Woodland (CES202.331-- BpS 1352) under a natural fire regime, but which have lost the pines by logging, southern pine beetle or senescence in the absence of fire, should probably be regarded as degraded examples of this system (NatureServe 2007).

Scale Description

These pine-dominated forests and woodlands occurred as large patches within a matrix of oak-dominated forests and woodlands.

NatureServe (2007) notes that contiguous bodies of this system probably once covered dozens to 100ac+. Patches often occur in complexes with other systems.

Issues/Problems

Comments

This model was based on R8TMPP -- Table Mountain/Pitch Pine, by Roger Fryar (9/2005), adapted on 8/15/2007 by Steve Croy, Margit Bucher, Sam Lindblom, Megan Sutton, and Gary Curcio, with assistance from Colleen Ryan.

Potential reviewers: Charles Lafon, Melissa VanGundy, Henri Grissino-Meyer, Chuck (CE) Williams(Clarion College?, PA), Wanda SanJule (VA TNC), Tom Waldrop (Clemson), Rick Meyers

Charles Lafon felt the following points made in the report are particularly important, because sometimes they are overlooked:
(1) It is noted that although the stands often are referred to as “ridgetop communities,” they actually cover larger areas, i.e., the south- and west-facing facets of spurs.
(2) The importance of patchiness in burning. Patchiness (along with temporal variability in fire return interval) likely was important for the survival of pine seedlings.
(3) The role of canopy-thinning disturbances other than fire (e.g., southern pine beetle, ice storms).

In addition, he made the following comment:
Concerning 2-9yr fire return interval. I think this interval is largely based on our fire history studies. I would clarify that this is the typical interval at which fires were recorded anywhere in our study sites (i.e., scarring at least one tree). Some of the fires may have burned only a portion of the study areas. Filtering out the potentially small-extent fires reveals slightly longer return intervals – on the order of 5-15yrs for the more widespread fires.

Vegetation Classes

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class A **12 %**

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIRI	Mid-Upper
PIPU5	Mid-Upper
QUCO2	Mid-Upper
QUPR2	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	100 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 0-15yrs). In this class, very dense regeneration of seedlings/saplings and coppice (scattered oak grubs, pine regeneration, and low shrubs) 5 to 15ft in height. No understory in the truest sense of the word. Scattered among the seedlings/saplings and coppice are developing clumps of warm-season grasses such as little bluestem, big bluestem, and Indian grass along with Ericaceous shrubs including Vaccinium, Gayluccia, Kalmia, and Pieris. Other commonly encountered plants are dry site sedges, bear oak, sweet fern, and composites. Fire is likely the dominant disturbance event, with surface fires occurring more frequently than stand-replacing fires. This class may persist on the landscape up to 15yrs.

With time and periodic surface fire, class A succeeds to class C. We estimate that fires may occur in this class every five years, but that stand replacement fires would only occur every 20yrs, maintaining this system in A. This accommodates periodic surface fires that are patchy and don't replace the whole stand. Parts of the landscape with a more frequent fire regime could be maintained as a grassland system and would be captured in a different model.

Class A alternatively succeeds to class B in the absence of fire for a period of 14yrs.

Class B **3 %**

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIRI	Mid-Upper
PIPU5	Mid-Upper
QUCO2	Mid-Upper
QUPR2	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	71 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 16-70yrs). This stage is a mid-seral closed stage dominated by dense oak and pine saplings in approximately equal amounts in oak and pine overstory with shade tolerant shrubs coming in under the tree saplings.

Class A succeeds to class B with the absence of fire for a period of 14yrs. The understory becoming sparse but including the same species as class A.

With time and no mixed severity fires, class B will succeed to class E (late closed stage). Very low intensity surface fires (five year probability) maintain this class. A mixed severity fire (50yr probability) would open up this mid-closed stage and transition it to class C. Replacement fires (75yr probability) transition this class back to A.

Invasions of pest/pathogens, likely pine beetles, may maintain this class in B (50yrs). Rare Catastrophic wind/weather events (500yrs) transition this class back to A, but more likely ice events (option1 - 250yrs)

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

may open this stand and transition it to C.

Class C **25 %**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

PIRI	Mid-Upper
PIPU5	Mid-Upper
QUCO2	Mid-Upper
QUPR2	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	70 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 16-70yrs). Mid-seral, open canopy. Pines in this class are equal to or more dominant than oaks. Woodland with herbaceous/grass and mixed low shrub understory. In the absence of frequent fire, woody understory increases in height and cover, including mountain laurel and other ericaceous species. Oak species found interspersed among the pines are multi-stemmed, a result of coppice from fire events.

Frequent surface fires and mixed-severity fires maintain this class. Frequent surface fires are modeled to have occurred with a five year probability with mixed severity fires at a 75yr probability. With time and fire the class would succeed to class D. Without fire for 20yrs the vegetation would close in and would transition to class B. Replacement fires (150yr probability) transition this class to A.

Invasions of pest/pathogens, likely pine beetles, may maintain this class in C (100yr probability), while rare catastrophic wind/weather events (1000yrs) transition this class back to A.

Class D **55 %**

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

PIRI	Upper
PIPU5	Upper
QUCO2	Mid-Upper
QUPR2	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	70 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 71yrs+). Late-development, open canopy pine to pine-oak. This class has the visual impression of a woodland, with scattered low-fire suppressed shrubs and interspersed grasses and herbs. Greater than 40% cover of herbaceous and graminoid species present in the groundcover

The vegetation of this class is similar to class C except that this class has more mature trees (over 70yrs in age). This class would be maintained by frequent surface fires with a five year probability and mixed fires with a 100yr probability. A replacement fire with a 200yr probability would send the class back to A. Lack of fire for 20yrs transitions this type to E.

Invasions of pest/pathogens, likely pine beetles, may maintain this class in D (75yr probability) while rare catastrophic wind/weather events (1000yrs) transition this class back to A.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class E **5 %**

Late Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

PIRI	Upper
PIPU5	Upper
QUCO2	Mid-Upper
QUPR2	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	71 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 71yrs+). Late-seral, closed canopy, pine-oak dominated overstory. Little herbaceous cover and dense shrub layer.

This class is a closed-canopy pine-oak forest that results after prolonged periods of fire suppression or microtopography that protects the forest from fires (approximately 50yrs+). A shift in dominance from pines to oaks would be expected in the absence of fire for long durations and would be hastened by ice storms and pine beetles. This class ranges from 71yrs to a mature persistent closed canopy forest. Class E could move to Class D (late open stage) with a mixed fire (75yr probability), or potentially to class D with an ice event (250yr probability).

Replacement fires transition this class to A (500year probability).

Invasions of pest/pathogens, likely pine beetles, may transition this class to D (75yr probability) while rare catastrophic wind/weather events (1000yrs) transition this class back to A.

Disturbances

Fire Regime Group:** I

Historical Fire Size (acres)

Avg 1000
Min 100
Max 10000

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	88.43			0.01131	5
Mixed	100.9			0.00991	5
Surface	5.422			0.18443	90
All Fires	5			0.20565	

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) Ice storm
☑ Wind/Weather/Stress ☐ Competition ☐ Other (optional 2)

References

Aldrich, Serena R. 2008 (expected). Fire regimes and successional dynamics of central Appalachian yellow pine forests. Ph.D. Dissertation, Department of Geography, Texas A&M University, College Station, in progress.

Aldrich, Serena R., Charles W. Lafon, Henri D. Grissino-Mayer and Jennifer A. Hoss. Three centuries of

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

fire and stand development in Pinus pungens stands on a central Appalachian landscape. Manuscript in preparation.

Brose, P.H. and Waldrop, T.A. 2006. Fire and the origin of Table Mountain pine-pitch pine communities in the southern Appalachian Mountains, USA. Canadian Journal of Forest Research 36: 710–718.

DeWeese, Georgina G. 2007 (expected). Range of variability in fire regimes of Table Mountain Pine (Pinus pungens Lamb.) stands, Jefferson National Forest, Virginia. Ph.D. Dissertation, Department of Geography, University of Tennessee, Knoxville, in progress.

DeWeese, Georgina G., Henri D. Grissino-Mayer and Charles W. Lafon. Evaluating the dendrochronological potential of central Appalachian Table Mountain pine (Pinus pungens Lamb.). Manuscript in preparation.

Fleming, G.P. and P.P. Coulling. 2001. Ecological Communities of the George Washington and Jefferson National Forests, Virginia: Preliminary Classification and description of Vegetation Types. Natural Heritage Technical Peport 01-14. VA Dept. of Con. & Rec.-Div. of Nat. Her., Richmond, Virginia. 372 pp.

Frost, C., Presettlement Fire Frequency Regimes of the United States: A First Approximation.Pages 70-81, May 1996., Proceedings of the 20nd Tall Timbers Fire Ecology Conference: Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescritpion. Tall Timbers Research Station, Tallahassee, FL.

Hoss, Jennifer A. 2007 (expected). Fire history and forest stand dynamics of the Narrows Preserve, Peters Mountain, Virginia. M.S. Thesis, Department of Geography, Texas A&M University, College Station, in progress.

Lafon, C.W., Kutac, M.J., 2003. Effects of ice storms, southern pine beetle infestation and fire on table mountain pine forests of southwestern Virginia. Physical Geography 24, 502-519.

Lafon, C.W., Hoss, J.A. and Grissino-Mayer, H.D. 2005. The contemporary fire regime of the central Appalachian Mountains and its relation to climate. Physical Geography 26: 126–146.

Lafon, C.W., Waldron, J.D., Cairns, D.M., Tchakerian, M.D., Coulson, R.N. and Klepzig, K.D. In press. Modeling the effects of fire on the long-term dynamics and restoration of yellow pine and oak forests in the southern Appalachian Mountains. Restoration Ecology.

Lafon, Charles W. and Henri D. Grissino-Mayer. 2006. Spatial patterns of fire occurrence in the central Appalachian Mountains and implications for wildland fire management. Physical Geography, in press.

Little, E.L., Jr., 1971, Atlas of United States trees, volume 1, conifers and important hardwoods: U.S. Department of Agriculture Miscellaneous Publication 1146, 9 pp., 200 maps. [Online]. Available:http://esp.cr.usgs.gov/data/atlas/little

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatrueServe Central Databases. Arlinton, VA U.S. A. Data current as of August 16, 2007.

Pfeffer, Michelle. 2005. Regression-based age estimates of yellow pine (Pinus) saplings, Jefferson National

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Forest, Virginia. Bachelor's Honors Thesis, Department of Geography, The University of Tennessee, Knoxville. 58 pp.

Sutherland, E. K., Grissino-Mayer, H. D., Woodhouse, C. A., Covington, W. W., Horn, S., Huckaby, L., Kerr, R., Kush, J., Moore, M. and Plumb, T. (1995) Two centuries of fire in a southwestern Virginia Pinus pungens community. In Inventory and Management Techniques in the Context of Catastrophic Events: Altered States of the Forest. University Park, PA: Pennsylvania State University, Center for Statistical Ecology and Environmental Statistics.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]: http://www.fs.fed.us/database/feis/.

Williams, C. E. and Johnson, W. C. (1990) Age structure and the maintenance of Pinus pungens in pine-oak forests of southwestern Virginia. American Midland Naturalist, Vol. 124, 130-141.

Williams, C.E. 1998. History and status of Table Mountain pine-pitch pine forests of the southern Appalachian Mountains (USA). Natural Areas Journal 18: 81–90.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713530 Southern Appalachian Low-Elevation Pine Forest

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

General Information

Contributors (also see the Comments field **Date** 7/26/2007

Modeler 1	Malcolm Hodges	mhodges@tnc.org	**Reviewer**
Modeler 2	Dan Chan	dchan@gfc.state.ga.us	**Reviewer**
Modeler 3	Louis Hyman	louis.hyman@forestry.alabama.gov	**Reviewer**

Vegetation Type
Forest and Woodland

Map Zone
57

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

Dominant Species*
PIVI2 QUCO2
PIEC2 CAGL8
QUFA VAPA4
QUPR2 GABA

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range
This system is found primarily in the Appalachian regions of KY and the Southern Blue Ridge in northern GA, western NC, southeastern TN, the Cumberlands of AL, parts of the Interior Low Plateau (e.g., the Knobs Region of KY), and southwestern VA (NatureServe 2007).

Biophysical Site Description
Occurs on a variety of topographic and landscape positions, including ridgetops, upper and midslopes, in mountain valleys and lower ranges. Bedrock may be a variety of types, but system is limited to acidic substrates (NatureServe 2007). This system consists of shortleaf pine- and Virginia pine-dominated forests in the lower elevation southern Appalachians and adjacent Piedmont and Cumberland Plateau, extending into the Interior Low Plateau of Kentucky and Tennessee. Fire is important in maintaining Shortleaf pine dominated types. The natural habitat of Virginia pine is xeric fire refuges such as exposed rock outcrops with patchy and light fuels. It is thus somewhat comparable to Table Mountain pine, but at lower elevations. Under natural conditions, it would occupy minor land area as a type but would have scattered individuals surviving in mixture with shortleaf pine.

This system is common to the Southern Appalachians but less so in the adjacent Piedmont, typically occupying xeric to dry sites at elevations generally below 700m on ridge tops, western, south and southwestern aspects. Occasionally Virginia pine is also found dry-mesic sites as a pioneering vegetation.

Vegetation Description
Vegetation consists of closed to open forest dominated by shortleaf pine (Pinus echinata) or Virginia pine (Pinus virginiana). Pitch pine (Pinus rigida) may sometimes be present. Hardwoods may be abundant at

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

times, especially dry-site oaks such as Quercus falcata, Quercus prinus and Quercus coccinea. Other overstory components vary with moisture regimes but could include several other pine species, red and white oaks, other hardwoods and/or eastern red cedar. Many stands are strongly even-aged and density-dependent based on age.

The hardwood component may be partly the result of fire suppression. The shrub layer may be well-developed, with Vaccinium pallidum, Gaylussacia baccata, or other acid-tolerant species most characteristic. Herbs are usually sparse but may include Pityopsis graminifolia and Tephrosia virginiana. Herbs probably were more abundant and shrubs less dense when fires occurred more frequently, and the communities of this system may have been grassy under more natural conditions, with Schizachyrium scoparium being a typical component, possibly with Danthonia sp (NatureServe 2007).

Virginia pine is an aggressive invader following disturbance and might be considered uncharacteristic vegetation on some sites. The frequency of its occurrence in the Southern Appalachian forested landscapes today is undoubtedly greater than in pre-settlement times. Its niche appears best fitted to xeric sites on thin soils (e.g. “necklace” stands adjacent to bluff lines in the Cumberlands and Appalachians). Virginia pine is increasingly at risk of mortality to disturbance agents as it matures. Older trees are particularly susceptible to pine beetle attacks due to slow radial growth and relatively high growing densities on often poor sites. Older trees are also more prone to windthrow. Few stands reach 100yrs of age with most stands “breaking up” at 50 to 75yrs of age.

Disturbance Description

Fire is an important influence and may be the only factor determining the occurrence of this system which would be a hardwood forest without fire. Fires were probably frequent and of low-intensity, or a mix of low- and high-intensity. Fire is important in determining the dominance of the two pines and the presence of the hardwood components and the overall vegetation structure.

Shortleaf pine (P. echinata) when mature is resistant to fire, while Virginia pine (P. virginiana) is less adapted to fire with thinner bark and higher mortality rates (particularly in young stands), and P. virginiana seedlings are easily killed by fire and will not resprout. It can however, survive repeated low intensity fires. The natural occurrence of P. virginiana on infertile, thin soils allows the community to persist in a specialized edaphic niche. It is a prolific seeder and is able to pioneer on these and other disturbed sites. P. virginiana often develops ‘red heart’ rot, caused by Fomes pini, at ages beyond about 60yrs. Virginia pine is very shallow rooted and susceptible to windthrow. Heavy snow and ice can create significant stand openings. Initial openings give rise to further windthrow and even larger openings as trees fall into gaps.

Under present conditions, the Southern pine beetle is an important factor in this system. Beetle outbreaks can kill pines without creating conditions for pines to regenerate.

In the absence of fire to maintain the ecosystem, natural Virginia pine stands could succeed to varying vegetation cover: (a) xeric oaks such as scarlet oak, chestnut oak, blackjack oak, and post oak; (b) mountain laurel, sourwood, red maple, and huckleberry; and (c) eastern white pine overstory.

Effects of logging and past clearing as well as fire suppression make understanding of this system's natural character and dynamics difficult. Some pine-dominated areas appear to be successional stands established in former hardwood forests after logging or cultivation, and would not be expected to have the same dynamics or ecosystem characteristics as natural pine forests maintained by fire. In natural pine forests,

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

logging may allow pines to regenerate or may change the composition to weedy hardwoods. It might alter canopy composition as well as structure (NatureServe 2007).

Adjacency or Identification Concerns

Examples with significant hardwood component may be classified as Southern Piedmont Dry Oak-(Pine) Forest (CES202.339 -- BpS1368). NatureServe (2007) also notes that this system probably usually bordered and intermixed with Southern Appalachian Oak Forest (CES202.886-- BpS1315) and Southern and Central Appalachian Cove Forest (CES202.373 -- BpS1318) may be present in more mesic areas. It may also intergrade into Southern Appalachian Montane Pine Forest and Woodland (CES202.331 -- BpS1352) at high elevations.

The relationship between this system and Southern Appalachian Montane Pine Forest and Woodland (CES202.331 -- BpS1352) may need further clarification. Southern Appalachian Low-Elevation Pine Forest (CES202.332) is distinguished by its occurrence as large patches on lower terrain (generally below 700m [2300ft]) and less extreme topography. The vegetation of the two systems may overlap but pitch pine and Table Mountain pine are more typical of the former, while shortleaf pine and Virginia pine are more typical of the latter (NatureServe 2007).

This system (CES202.332) at its western extent in central Tennessee would be distinguished from equivalent Ozarkian systems (e.g.,Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313 -- BpS1367)) by the presence of Pinus virginiana and Quercus prinus, which do not cross the Mississippi River (NatureServe 2007).

Native Uncharacteristic Conditions

Absence of fire without pine reproduction may lead to succession to hardwood forest types.

Effects of logging and past clearing as well as fire suppression make understanding of this system's natural character and dynamics difficult. Some pine-dominated areas appear to be successional stands established in former hardwood forests after logging or cultivation, and would not be expected to have the same dynamics or ecosystem characteristics as natural pine forests maintained by fire. In natural pine forests, logging may allow pines to regenerate or may change the composition to weedy hardwoods. It might alter canopy composition as well as structure (NatureServe 2007).

Scale Description

Spatial scale and pattern are generally characterized as large patch. Most remnants in relatively natural condition are probably small patches. In its most natural setting, topography generally limits the patch size of the ecological community.

Issues/Problems

Adjusted class landscape percents so that class E had one percent by adjusting class D from 34% to 33% (Landsum can't handle 0 percent classes) - MHW MiFSL 3/19/08.

Comments

NOTE: 2/26/09: As a result of final QC for LANDFIRE National by Jennifer Long the user-defined min and max fire return intervals for mixed severity fire was deleted because they were not consistent with the modeled fire return interval for this fire severity type.

This BpS is really a combination of Rapid Assessment model descriptions for R8PIVlap - Appalachian Virginia Pine and R8PIECap - Appalachian Shortleaf Pine. The RA modeler for each was Roger D. Fryar

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

and each was reviewed by Ron Stephens rstephens@fs.fed.us.

Vegetation Classes

Class A 32 %

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 7

Indicator Species* and Canopy Position

PIVI2	Upper
PIEC2	Upper
VACCI	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	90 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class age 0-10yrs. Dense seedling and sapling stands with variable herbaceous or woody understory vegetation. Stands originating from Virginia pine forests may have dense pine seedlings with very little understory. Shortleaf-originating stands may include hickory, yellow poplar, dogwood, blueberry, blackberry, huckleberry, grasses and forbs.

Class B 2 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PIVI2	Upper
VACCI	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	100 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class age 11-30yrs. Poletimber and small sawtimber stands dominated by Virginia pines with minor components of shortleaf pine and other woody and herbaceous vegetation. Stands are often dense.

Class C 32 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PIEC2	Upper
PIVI2	Upper
QUERC	Low-Mid
CARYA	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	50 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class age 11-30yrs. Canopy trees are dominated by shortleaf pine, relatively open with grassy understory. Oak and hickory may also be present in canopy or midstory. Virginia pine may be present in pockets protected from fire.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class D 33 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PIEC2	Upper
QUERC	Mid-Upper
CARYA	Mid-Upper
COFL2	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	31 %	70 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class age 31yrs+. Canopy is dominated by shortleaf pine. Some open parklike stands with grassy understories; overstory contains varying amounts of pine, oak and hickory. Variable midstory development possible with dogwood, oak and hickories.

Class E 1 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PIVI2	Upper
VACCI	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class age 31yrs+. Small sawtimber stands dominated by Virginia pines with gaps occurring from tree mortality caused by native insects, wind, ice and snow.

Disturbances

Fire Regime Group:** I

Historical Fire Size (acres)

Avg 100
Min 10
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	25.28	25	125	0.03955	14
Mixed	144.9			0.00690	2
Surface	4.203	5	15	0.23795	84
All Fires	4			0.28441	

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

References

Brown, James K. and 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.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Little, E.L., Jr., 1971, Atlas of United States trees, volume 1, conifers and important hardwoods: U.S. Department of Agriculture Miscellaneous Publication 1146, 9 pp., 200 maps. [Online]. Available: http://esp.cr.usgs.gov/data/atlas/little.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 15 April 2007.

Schmidt, Kirsten M, Menakis, James P., Hardy, Colin C., Hann, Wendel J., Bunnell, David L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 pp. + CD.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/

USDA Forest Service, Southern Forest Research Station, Southern Forest Resource Assessment, [Online]. Available: http://www.srs.fs.fed.us/sustain

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713680 Southern Piedmont Dry Oak(-Pine) Forest

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

General Information

Contributors (also see the Comments field **Date** 7/25/2007

Modeler 1	Robin Mackie	rmackie@fs.fed.us	**Reviewer**	Milo Pyne	milo_pyne@natureserve.org
Modeler 2	John Mason	john_mason@fws.gov	**Reviewer**	Robin Mackie	rmackie@fs.fed.us
Modeler 3	Gary Curcio	gary.curcia@ncmail.net	**Reviewer**	John Mason	John_Mason@fws.gov

Vegetation Type
Forest and Woodland

Map Zone
57

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

Dominant Species*

QUAL	CAAL27
QUFA	VACCI
PIEC2	SCSC
CAGL8	SONU2

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range

Matrix forests of the southern Piedmont ranging from VA to AL, the eastern toe of Appalachians to the western margin of the Atlantic Coastal Plain (the Fall Line).

The northern range limit in VA, where this system overlaps with Central Appalachian Dry Oak-Pine Forest (CES202.591 -- BpS1369), needs to be determined (NatureServe 2007).

Biophysical Site Description

The piedmont has mostly gently rolling topography ranging from 300-1200ft elevation. Several erosion resistant metamorphic and igneous rock types have left monadnocks that stand 200-1000ft above the remaining landscape. Average annual precipitation 44-48". The original vegetation as described by early explorers and the first settlers was a mosaic of forest and open woodland, with interspersed savannas or prairies (Lederer 1672, Logan 1859). The prairie component was located on the flat to convex and gently rolling uplands of the larger fire compartments. The largest of these in the southern part of the range was up to five miles wide without a tree or only a few blackjack oaks (Logan 1859).

NatureServe (2007) notes that this system occurs on upland ridges and upper to mid slopes, occupying most of the uplands where soils are not rocky or otherwise extreme. Moisture conditions, determined by topography, are dry to dry-mesic. This system may occur on any kind of rock type, with rock chemistry being an important determinant of variation. Soils include almost the full range of upland soils, with only the shallowest rocky soils and those with extreme clay hardpans excluded.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

This system encompasses the prevailing upland forests of the southern Piedmont. High-quality and historic examples are typically dominated by combinations of upland oaks, sometimes with pines as a significant component, especially in the southern portions of the region. These forests occur in a variety of habitats and, under natural conditions, were the matrix vegetation type covering most of the landscape.

Although these forests have often been called "oak-hickory" (Braun 1950) or "oak-pine-hickory" (Kuchler 1964, Greller 1989, Skeen et al. 1993), Monk et al. (1990) concluded there was insufficient abundance of hickory to justify including this genus in the name of such forests.

There are fairly dramatic differences in the amount of pine present across the modern day Piedmont landscape, with it being especially prevalent in South Carolina, Georgia, and Alabama (USGS 1992). To some extent, the prevalence of pine in these southern portions of the region may represent natural conditions (Nelson 1957). It is possible that the more heavily mixed or pine-dominated forests of the southern Piedmont should be recognized as a different system, but distinguishing natural examples is difficult given a long history of land-use impacts and resulting vegetational changes in the region (Brender 1974).

In addition, Skeen et al. (1993) assert that "the oak-hickory-pine designation may be reflective of past land use and disturbance history and that the steady-state typal forest of the southeastern Piedmont is in reality oak-hickory-yellow poplar."

Vegetation Description

The vegetation composition depended greatly upon local site conditions and disturbance history of an area. Locally, the species that compose the system are strongly influenced by soil, slope and aspect (Eyre 1980). Where fire is most frequent the system may develop a relatively pure canopy of shortleaf pine typified by a very open woodland structure with scattered overstory trees and an herbaceous-dominated understory; such examples are rare on the modern landscape (NatureServe 2007). Shortleaf pine (Pinus echinata) dominates drier south and west facing slopes often with white oak (Quercus alba), post oaks (Q. stellata) and mockernut hickory (Carya alba). With frequent fire (2-3yrs) open prairie-like areas and the grassy understory beneath woodland trees were dominated by tallgrass species such as little bluestem (Schizachyrium scoparium) and Indiangrass (Sorghastrum nutans) on the drier sites, with switchgrass (Panicum virgatum) and big bluestem (Andropogon gerardii) in moist swales. The grasses were interspersed with a diverse assortment of perennial forbs including several native legumes (Davis, 1996; Barden, 1997; DeSelm & Murdock, 1993).

On moister areas like north slopes and sites that burned at a lower intensity due to partial protection from natural landscape features, more densely forested conditions prevail. Southern red oak (Quercus falcata), white oak (Quercus alba) and black oak (Q. velutina) were frequent. Chestnut oak (Quercus montana), mockernut hickory (Carya alba) and, historically, American chestnut (Castanea dentata) forest may have been found. Shortleaf pine (Pinus echinata) and more uncommonly on upland sites, loblolly pine (Pinus taeda) co-occurred with oaks. Following disturbance, many such areas would also support sweetgum (Liquidambar styraciflua), tulip poplar (Liriodendron tulipifera), red maple (Acer rubrum) and black gum (Nyssa sylvatica). The midstory typically contained dogwood (Cornus florida), sourwood (Oxydendrum arboretum), blackgum (Nyssa sylvatica) and sweetgum (Liquidambar styraciflua). The shrub layer included blueberries (Vaccinium sp.), huckleberries (Gaylussacia sp.), beautyberry (Callicarpa americana), St. John's wort (Hypericum sp.) and the vines Carolina Jessamine (Gelsemium sempervirens) and wild grape (Vitis rotundifolia) (NatureServe, 2007). Understory of more forested areas was variable.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

NatureServe (2007) notes that in successional forest examples of this system, recovering from clearcutting or cultivation, the pines dominate for a number of decades, with oaks and hickories gradually invading the understory.

NatureServe (2007) also adds that these forests appear to occur naturally as predominantly old-growth, with canopy dynamics dominated by gap-phase regeneration. Small to medium-sized canopy gaps created by wind are the primary natural disturbance at present, and probably were in the past as well. Fire likely created some small to medium-sized gaps in the past also, and likely caused all canopy gaps to persist longer. The dominant trees are capable of living for several centuries. Most of the canopy species are only moderately tolerant of shade. In recent years, more shade-tolerant species appear to be increasing in many of these forests, particular Acer rubrum. This may be a result of loss of regular fire in the system.

Disturbance Description

Fire and grazing are possibly the most important natural processes affecting the floristic composition and vegetation structure of this system (NatureServe 2007). The presence of frequent (2-5yrs) surface fire is important in order to support the reproduction of shortleaf pine (Pinus echinata) and the development of herbaceous understories. Shortleaf pine is a shade-intolerant species and does not survive or grow well when fire is suppressed. Where fire is most frequent, the system may develop a relatively pure canopy of shortleaf, typified by a very open woodland structure with scattered overstory trees and an herbaceous-dominated understory.

The frequency of fire is variable across the landscape to create a mosaic of vegetation. However, most agree that the inter-fire interval was relatively short. Fire may have been as frequent as every 2-3yrs. Brewer (2001) compared the current tree species composition to bearing tree records, and found that shortleaf pine and more fire tolerant species such as blackjack oak, black oak, and post oak were prevalent on the landscape, indicating a greater fire frequency. Without a short fire return interval community succession tends to favor upland mixed pine-xeric hardwood forests or hardwood dominated forests. Landers (1989) inferred a fire-return interval of 10 times per century for pure stands of Pinus echinata.

Lightning fires occurred primarily during the spring dry season (April and May) with a second peak of native American burning during the fall (October and November). Occasionally, during extensive droughts, mixed severity or stand replacement fires did occur, especially on drier pine-dominated sites. Local thunderstorms and outbreaks of Dendroctonus frontalis (Southern Pine Beetle) created gaps on a small but continual basis. More extensive regional disturbances included tropical storms during the growing season, ice storms during winter, and tornadoes throughout the year.

Adjacency or Identification Concerns

Grades into Appalachian shortleaf pine/ oak hickory pine above approx 1200ft and longleaf pine to the east (with rare patches in the Piedmont). NatureServe (2007) notes that the range of this system overlaps with East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483 -- BpS1307) in the Fall Line Hills ecoregion (65i) of Alabama and in the Southern Hilly Gulf Coastal Plain ecoregion (65d) of Mississippi and may overlap to some degree with Southern Coastal Plain Dry Upland Hardwood Forest (CES203.560 -- BpS1330) as well. In parts of the overlapping range (including the Oakmulgee Ranger District of the Talladega National Forest), these types occur in a mosaic which is difficult to interpret environmentally and ecologically (A. Schotz pers. comm.). On the piedmont there were smaller and more dispersed prairies which included several distinct types depending upon soils and geological substrates such as diabase and serpentine. These areas may remain open longer under infrequent fire conditions because of the edaphic factors which retard woody succession.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Native Uncharacteristic Conditions

Loblolly pine widely established by the CCC and for timber production following cotton farming across the landscape. There is a much more prolific loblolly pine seed source than occurred historically. Eroded soils are prevalent as is littleleaf disease which affects shortleaf pine abundance and ability to reestablish. Seed sources for herbaceous and oak species depleted to due lack of fire, competitive exclusion with successional and non-native invasive plant species, and history of agricultural production in these systems. Sweetgum, red maple, loblolly pine, black gum, tulip poplar are more common due to lack or exclusion of frequent fire.

Scale Description

Naturally a matrix system with contiguous patches covering many thousands of acres,and dominating most of the upland landscape in the Piedmont. Remnants are mostly large patch, but some large expanses remain (hundred of acres). A few areas have substantially forested landscapes in which oak-hickory forests in some condition cover thousands of acres in nearly contiguous patches (NatureServe 2007).

Surface fires may range in size from 10-5000ac+. Within this vegetation there was considerable patchiness in overstory species composition. This was related to topography and disturbance. In openings created by windthrow and disease, regeneration occurred. Larger gaps were created by tropical storms, tornadoes, or bark beetle outbreaks. Also, large opening were created by replacement fires following extensive droughts coupled with severe bark beetle mortality.

Issues/Problems

A landscape fragmented within urban areas is difficult to burn at a landscape scale. This vegetation type has been altered through land use conversion (agriculture, development, loblolly pine plantations) and fire suppression. So much of this vegetation type is currently composed of successional forests that have arisen after repeated cutting, clearing, and cultivation of original oak-hickory forests (NatureServe 2007).

Comments

NOTE: 2/26/09: As a result of final QC for LANDFIRE National by Jennifer Long the user-defined min and max fire return intervals for replacement and mixed severity fire were deleted because they were not consistent with the modeled fire return intervals for these fire severity types.

The description and VDDT model for this BpS is based on the rapid assessment model R9OHPI (Coastal Plain Pine Oak Hickory) developed by K. Outcalt and C. Frost.

Vegetation Classes

Class A **10 %**

Early Development 1 All Structure

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 6

Indicator Species* and Canopy Position

PIEC2	Upper
QUAL	Upper
VAAR	Low-Mid
SCSC	Lower

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

(Class age 0-15yrs). Pine and oak reproduction to 15ft tall. Community of forbs and perennial grasses. More common on dry sites dominated by pines susceptible to fire & pine beetles. Forms as small openings with

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

scattered live trees surviving recent disturbance.

Class B 15 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

PIEC2	Upper
QUAL	Upper
LITU	Upper
COFL2	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	75 %	100 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 16-75yrs) Closed canopy with high stem density, oaks and other hardwoods on mid and lower slopes with shortleaf, loblolly pine. Reduced herbaceous understory resulting from shade. > 75% canopy cover, midstory developing.

In the absence of probabalistic events, class B will succeed to class E after the canopy exceeds 75yrs in age. Rare replacement fires, occurring once every 300yrs will return class B to the early post-replacement stage. Surface fires may occur in class B every 20yrs, but these are not intense or frequent enough to kill the overstory or thin the midstory. More intense mixed fires, occurring once every 50yrs, can reduce the overstory and midstory, and drive the system to a more open condition characteristic of class C. Ice or wind storms occurring once every 300yrs will return class B to the early post replacement class.

Class C 25 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

PIEC2	Upper
QUST	Upper
VAAR	Low-Mid
SCSC	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	70 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 16-75yrs). Class C is a prairie savanna, and/or open woodland with pines, oaks, shrubs and a grass/forb dominated understory. The overstory trees in class C generally range from 16 to 75yrs of age.

With surface fire occurring every four years on average, class C will retain an open structure and succeed into class D after the canopy reaches 75yrs old. In the absence of fire for more than 12yrs, a midstory will develop and class C will transition into class B. Rare replacement fires may occur every 200yrs and return class C to the early post-replacement condition. Severe wind or weather stresses, occurring once every 300yrs, can also return class C to the early post-replacement phase.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class D 40 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

PIEC2	Upper
QUST	Upper
VAAR	Lower
SCSC	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	70 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Herbaceous understory predominant on upper south facing slopes.

Description

(Class age 76yrs+.). Class D is a prairie, savanna, and open woodland with large pines and oaks, with shrubs and a grass/forb dominated understory. The overstory is generally greater than 76yrs old.

With surface fires occurring on average once every four years, class D will retain the open, old growth structure. If fire is removed from the system for more than 15yrs, class D will develop a midstory and transition into class E through an alternative successional pathway. Rare replacement fires may occur once every 300yrs during extremely dry conditions and return class D back to the early post-replacement phase. Insect and disease outbreaks, occurring once every 300yrs, and wind/weather stresses, occurring once every 300yrs, can also return class D to the early post-replacement phase.

Class E 10 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

CAAL27	Upper
QURU	Upper
LITU	Upper
QUAL	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	71 %	100 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 76yrs+.). This class represents a closed-canopy late-seral stage with 76-300yrs+ trees. The closed canopy is dominated by oaks and hickory, with understory components including American beech, red maple, dogwood, sourwood, sassafras and black gum. The precise composition will vary depending on slope and aspect. Moister and slightly fire sheltered north slopes will have a greater tendency to support Northern red oak (Quercus rubra) instead of white oak. The lower strata will tend to be shrub-dominated (for example by Vaccinium species) with a sparse herb layer composed of forbs to the exclusion of grasses.

Disturbances

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Fire Regime Group:** I

Historical Fire Size (acres)

Avg 2500
Min 50
Max 5000

Sources of Fire Regime Data

- [x] Literature
- [ ] Local Data
- [ ] Expert Estimate

Additional Disturbances Modeled

- [x] Insects/Disease
- [x] Wind/Weather/Stress
- [x] Native Grazing
- [ ] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	322.6			0.0031	2
Mixed	232.6			0.0043	2
Surface	5.488	1	10	0.1822	96
All Fires	5			0.1896	

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.

References

Barden, L.S. 1997. Historic prairies in the piedmont of North and South Carolina, USA. Natural Areas Journal 17: 149-152.

Braun, E. L. 1950. Deciduous forests of eastern North America. Hafner Press, New York. 596 pp.

Brender, E. V. 1974. Impact of past land use on the lower Piedmont forest. Journal of Forestry 72: 34-36.

Brewer, J. Steven. 2001. Current and presettlement tree species composition of some upland forests in northern Mississippi. Journal of the Torrey Botanical Society 128: 332-349.

Davis, J.E., Jr. 1996. Restoration of a piedmont prairie: potential species composition and demographics of the federally endangered sunflower Helianthus schweinitzii T&G (Asteraceae). Master's thesis, University of North Carolina at Charlotte, Charlotte, NC.

DeSelm, H.R. and N. Murdock. 1993. Grass dominated communities. Pages 87-141 in W.H. Martin, S.G Boyce and A.C. Echternacht, editors. Biodiversity of the Southern United States: Upland terrestrial communities. John Wiley and Sons, New York.

Eyre, F. H., editor. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC. 148 pp.

Greller, A. M. 1989. Correlation of warmth and temperateness with the distributional limits of zonal forests in eastern North America. Bulletin of the Torrey Botanical Club 116: 145-163.

Kuchler, A. W. 1964. Potential natural vegetation of the conterminous United States. American Geographic Society Special Publication 36. New York, NY. 116 pp.

Landers, J. L. 1989. Disturbance influences on pine traits in the southeastern United States. Pages 61-98 in: Proceedings 17th Tall Timbers Fire Ecology Conference. High intensity fire in wildlands: Management challenges and options. May 18-21, 1989. Tallahassee, Florida.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Lederer, John, 1672 [1966] The Discoveries of John Lederer, translated by Sir William Talbot, Readex Microprint, 1966.

Logan, John H. 1859. A history of the upper country of South Carolina. Vol. I (Vol. II never pub.) S.G. Courtenay & Co., Charleston, S.C. 521 pp.

Monk, C. D., D. W. Imm and R. L. Potter. 1990. Oak forests of eastern North America. Castanea 55(2): 77-96.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 08 June 2007.

Nelson, T. C. 1957. The original forests of the Georgia Piedmont. Ecology 38: 390-397.

Skeen, J. N., P. D. Doerr and D. H. Van Lear. 1993. Oak-hickory-pine forests. Pages 1-33 in: W. H. Martin, S. G. Boyce and A. C. Echternacht, editors. Biodiversity of the Southeastern United States: Upland Terrestrial Communities. John Wiley & Sons, New York. 373 pp.

USGS [U.S. Geological Survey]. 1992. National land cover dataset. U.S. Geological Survey, EROS Data Center, Sioux Falls, SD. Nelson, T. C. 1957. The original forests of the Georgia Piedmont. Ecology 38: 390-397. Brender, E. V. 1974. Impact of past land use on the lower Piedmont forest. Journal of Forestry 72: 34-36.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713760 Southern Ridge and Valley/Cumberland Dry Calcareous Forest

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

General Information

Contributors (also see the Comments field **Date** 9/30/2005

Modeler 1	Milo Pyne	milo_pyne@natureseve.org	**Reviewer**
Modeler 2	Sue Gawler	sue_gawler@natureseve.org	**Reviewer**
Modeler 3			**Reviewer**

Vegetation Type
Forest and Woodland

Map Zone
57

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

Dominant Species*
QUST VIBUR
QUAL SCSC
QUSH
JUVI

General Model Sources
☑ Literature
☐ Local Data
☐ Expert Estimate

Geographic Range
This system includes dry to dry mesic calcareous forests of the Southern Ridge and Valley region of AL and GA, extending north into TN, KY, VA and adjacent WV. It includes calcareous forests on lower escarpments of the Cumberland Plateau and other related areas.

Biophysical Site Description
Examples of this forest and woodland system occur usually on dry sites, on a variety of topographic and landscape positions including slopes (particularly south- and west-facing ones), ridges, and knobs, depending on where the base-rich rock is present or crops out, and where the soils are influenced by calcareous/circumneutral geology. Elevation is generally between 200 and 500 meters.

Vegetation Description
Oaks dominate the overstory of most natural stands, if they have not been preferentially removed. Tree species include white oak, post oak, chinquapin oak, Shumard oak, black oak and hickory species with eastern red-cedar, possibly mixed with shortleaf pine. Midstory species in natural systems are primarily oak , but can include sugar maple, American beech, dogwood, hickories, ashes, elms, hackberry/sugarberry, Eastern red-cedar, hop-hornbeam, redbud, black locust, black cherry, sassafras and possibly sprouts of American chestnut. Eastern red-cedar coverage will be limited or reduced in examples with more frequent fire, but it may dominate a midstory layer in conditions of infrequent fire. The shrub layer is typically characterized by non-ericads (but possibly with deerberry [Vaccinium stamineum]), Viburnum species, Crataegus species and Philadelphus species. Ground cover typically includes little bluestem (Schizachyrium scoparium), Yellow Indian grass (Sorghastrum nutans), calciphilic sedges

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

(Carex spp.) and a variety of herbaceous plants. More mesic inclusions may have serviceberry, basswood, or American holly in the tree layers and Viburnum, dogwood, sawbrier (Smilax glauca), greenbrier (Smilax rotundifolia), wild grape (Vitis spp.) and others in the shrub layer. Without periodic fire, advanced oak regeneration is usually absent except on xeric sites. With even shorter fire return intervals (or more intense growing-season burns) successional shifts of oak forest and woodlands to savannas or to woodlands are possible.

Disturbance Description

Fire regime group I, with frequent surface fires. Pre-settlement fire return intervals are believed to have ranged from 3-14yrs. Natural fire regimes were primarily surface fires during the dormant season with occasional growing season mosaic fires (most likely occurring infrequently once or twice every 20-25yrs).

Windthrow and ice damage can be important agents in opening the canopy.

Adjacency or Identification Concerns

In the absence of fire, mesophytic species (e.g. yellow poplar, sugar/red maples and others) could replace oaks over time. Widespread oak decline could dramatically change dominance regimes. Nonnative invasive plant species (most notably Ailanthus, Asiatic bittersweet, Japanese honeysuckle, and kudzu) along with insects (most notably gypsy moth) can also exacerbate community shifts.

Native Uncharacteristic Conditions

Scale Description

This is a large-patch type, generally occupying distinct physiographic settings (ridges, upper slopes, lower south and west-facing slopes) on the order of 100s of hectares, rather than extending over large continuous areas.

Issues/Problems

The FRCC type was originally described for Cumberlands and Southern Appalachians, but the concept incudes the most exposed mid-elevation ridges and lower slopes of the Cumberland Plateau escarpment, where base-rich rocks and resultant soils are present.

Comments

This BpS model description and VDDT model is based on the Rapid Assessment Eastern Dry-Xeric Oak Pine model (R7OAPIdx), created by Sue Gawler (sue_gawler@natureserve.org), Doug Wallner (Doug_Wallner@nps.gov), and Roger Fryar. Roger Fryar's name was included as a modeler even though he was not at the northeast meeting, since the material here started as his FRCC description (OKHK1). Note that age ranges for classes are from the original Fryar model as further information unavailable while modifying model 2/16/05.

**The FRCC type was originally described for Cumberlands and Southern Appalachians, but the concept includes the most exposed mid-elevation ridges and lower slopes of the Cumberland Plateau escarpment, where base-rich rocks and resultant soils are present.

Vegetation Classes

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class A **7 %**

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 2

Indicator Species* and Canopy Position

QUAL	Upper
QUST	Upper
JUVI	Middle
SCSC	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	25 %
Height	Shrub 0.6m	Shrub >3.1m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Some examples are more open, but trees are typically the dominant life form.

Description

(Class age 0-14yrs): Oak and eastern redcedar reproduction to 15ft tall and about 15yrs old. Community of forbs and perennial grasses. More persistent on dry sites. Openings tend to be small and have scattered live trees. < 25% tree canopy cover. Review Comments 11/07: To follow LANDFIRE modeling rules, changed the TSD to 13yrs [No significant impact on model outputs].

Class B **5 %**

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

JUVI	Mid-Upper
ACSA3	Upper
QUAL	Mid-Upper
LITU	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	80 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 15-59yrs): Mid-development (15-60yrs) with closed canopy, oak with Eastern red-cedar with little or no herbaceous understory. Some woody understory development. > 50% canopy cover (crown closure estimate). In the continued absence of fire, stands may become heavily dominated by E. red-cedar with mesophytic species (e.g. yellow poplar, sugar, red maple, black gum) likely to replace oaks.

Class C **22 %**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

QUST	Upper
QUAL	Upper
SCSC	Lower
DASP2	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	50 %
Height	Tree 5.1m	Tree 10m
Tree Size Class	Medium 9-21"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Ground layer (herbs and sometimes dwarf shrubs) could exceed tree cover, but this is not typical.

Description

(Class age 15-59yrs): Mid-development (15-60yrs), open canopy. Woodland with herbaceous and/or low shrub understory. Oak (white, post) with limited Eastern red-cedar < 50% canopy cover. Schizachyrium scoparium most typical grass.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class D 51 %

Late Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

QUST	Upper
QUAL	Upper
SCSC	Lower
DASP2	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	50 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

Ground layer (herbs and sometimes dwarf shrubs) could exceed tree cover, but this is not typical.

Description

(Class age 60yrs+): Late-development (>60yrs), open canopy pine-oak to oak-pine in composition. Late-seral oak woodland (white, post) with limited eastern redcedar <50% canopy cover. Schizachyrium scoparium most typical grass.

Class E 15 %

Late Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

QUAL	Upper
ACSA3	Upper
JUVI	Mid-Upper
VIBUR	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	80 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 60yrs+): Late-seral (>60yrs), closed canopy, oak dominated overstory community, possibly with "mesic" species (e.g. sugar maple) with little herbaceous cover. May have a dense woody shrub understory layer. Canopy gaps occupying 1-2%, larger openings represent 1-2% of landscape respectively >50% canopy cover (crown closure estimate).

Disturbances

Fire Regime Group: I**

Historical Fire Size (acres)

Avg 100
Min 50
Max 500

Sources of Fire Regime Data

☑ Literature
☐ Local Data
☐ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	186.7			0.00536	4
Mixed	109.6			0.00912	6
Surface	7.767			0.12876	90
All Fires	7			0.14323	

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)

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

References

Abrams, M.D., D.A. Orwig, M.J. Dockry. 1997. Dendroecology and successional status of two contrasting old-growth oak forests in the Blue Ridge Mountains, USA. Can J. For. Res. 27: 994-1002.

Harrod, J.C., M. E. Harmon and P. S. White. 2000. Post-fire succession and 20th century reduction in fire frequency on xeric southern Appalachian sites. J. Veg. Sci. 11: 465-472.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 08 June 2007.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5713770 Central Appalachian Pine-Oak Rocky Woodland

☐ *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 Jim Vanderhorst	jimvanderhorst@wvdnr.gov	**Reviewer**	
Modeler 2 Carlen M. Emanuel	cemanuel@tnc.org	**Reviewer**	
Modeler 3		**Reviewer**	

Vegetation Type
Forest and Woodland

Map Zone
57

Model Zone

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

Dominant Species*

PIRE	QUCO2
PIRI	QUIL
PIPU5	KALA
QUVE	GABA

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range

Scattered areas throughout Ridge and Valley of the Central Appalachians in WV and possibly extending into western VA.

NatureServe (2007) describes this system as occuring from central New England south to VA and WV (see Central Appalachian Pine-Oak Rocky Woodland (CES202.600).

Ridge and valley province – stands occur as scattered patches, cooman on crests of upper slopes of the ridges, shale barrens of eastern WV (for VA, WV, KY) (SAF 1980).

Biophysical Site Description

This forest type occurred where geological formations formed rocky cliffs and ridgetops, outcroppings, and steep slopes, mostly at lower elevations but occasionally occurring at elevations between 1000 and 4200ft msl (1220 m). In West Virginia, elevations are typically between 2000-4200ft msl, and are usually the highest points in the immediate landscape. Aspects on slopes are typically southerly and westerly. This forest occurs east of the Allegheny Mountains, in the rain shadow. The substrate is derived from sandstone. The soils are shallow and droughty, with varying accumulations of litter and duff.

Conditions are dry and nutrient-poor, and many, if not most, sites have a history of fire (NatureServe 2007).
This group contains species-poor, fire-influenced, mixed woodlands of xeric, exposed montane habitats. Communities in this group occur in the Appalachians from New York south to northern Georgia. Sites are typically located on convex, south to west facets of steep spur ridges, narrow rocky crests, and cliff

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

tops. Pine – Oak / Heath woodlands are widespread throughout both the Ridge and Valley and Blue Ridge provinces in western Virginia. They occur at elevations from below 300m (1000ft) to more than 1200m (4000 ft) on various substrates, but most commonly on acidic, sedimentary and metasedimentary substrates, e.g ., sandstone, quartzite, and shale. A few stands occur on Piedmont monadnocks and foothills. Soils are very infertile, shallow, and droughty (Va Nat Her 2007).
The type is restricted to poor, dry sites which have been disturbed in the recent past by heavy cutting, fire, or both. Thin, rocky soils in the mountainous areas. Soil stongly acid and devoid of nutrients, and low precip in shale barrens of eastern WV and adjacent states (SAF 1980).

Vegetation Description

These woodlands and forests are dominated by dry site pine species mixed with some oaks. Individual stands may be dominated or co-dominated by pitch pine (Pinus rigida), red pine (Pinus resinosa), table mountain pine (Pinus pungens) and Virginia pine (Pinus virginiana). Associated deciduous trees include black oak (Quercus velutina), scarlet oak (Quercus coccinea), chestnut oak (Quercus prinus) and black gum (Nyssa sylvatica). Associated shrub species include mountain laurel (Kalmia latifolia), scrub oak (Quercus ilicifolia) and black huckleberry (Gaylussacia baccata) and blueberries (Vaccinium sp.). Physiognamy ranges from tall, closed canopy red pine forests to dwarf pitch pine forests to open woodlands with varying pine and oak co-dominance.

The vegetation is patchy, with woodland as well as open portions. Pinus spp. are diagnostic and often are mixed with xerophytic Quercus spp. Some areas have a fairly well-developed heath shrub layer, others a graminoid layer (NatureServe 2007).

Short-statured table-mountain pine (Pinus pungens) and pitch pine (Pinus rigida) are usually the dominants forming an open overstory, often with co-dominant chestnut oak (Quercus montana, = Quercus prinus). Less important tree associates include scarlet oak (Quercus coccinea), Virginia pine (Pinus virginiana) and sassafras (Sassafras albidum). Except in the Piedmont stands, bear oak (Quercus ilicifolia) is characteristically abundant in the shrub layer, along with various ericaceous species. Colonial shrubs usually pre-empt available microhabitats for most herbaceous species, but bracken fern (Pteridium aquilinum var. latiusculum) and turkey-beard (Xerophyllum asphodeloides) are often competitive enough to achieve significant cover (Va Nat Her 2007).

Shrub or dwarf bear oak, pitch pine, SCO, CHO, WO, BJO, PTO, NRO, low bush blueberry, huckleberry, mountain laurel, sheep-laurel, sweetfern, teaberry, beardgrass, poverty oat grass (SAF 1980)

The globally rare variable sedge (Carex polymorpha), the state-rare northern pine snake (Pituophis melanoleucus melanoleucus) and several rare moths, all bear oak feeders, are locally associated with these woodlands. More common and conspicuous animals often found in these dry, rocky, semi-open habitats include the northern fence lizard (Sceloporus undulatus hyacinthinus) and the five-lined skink (Eumeces fasciatus) (Va Nat Her 2007).

A subset of northern and central Appalachian Pine-Oak / Heath communities that occurs on exposed, high-elevation summits of sedimentary ridges are sometimes referred to as montane or Appalachian “pine barrens.” Although these communities are fire-influenced, the vegetation retains a dwarfed, shrubland (less than six meters [20ft] tall) physiognomy even during long absences of fire due to extremely shallow, xeric soils and constant exposure to severe winds and ice. Only one occurrence of such a “pine barren” is documented in Virginia, covering about 60 ha (150 ac) on Warm Springs Mountain (Bath County), at elevations between 1100-1200m (3600-4000ft). Larger examples occur in nearby West Virginia at

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

elevations from 1200-1375m (4000-4500ft) on the summit of North Fork Mountain (Pendleton County). The singular Virginia occurrence is characterized by dense, nearly impenetrable thickets of Catawba rhododendron (Rhododendron catawbiense), bear oak (Quercus ilicifolia), mountain-laurel (Kalmia latifolia), black huckleberry (Gaylussacia baccata) and late lowbush blueberry (Vaccinium angustifolium), with scattered emergent (but still shrub-sized) pitch pines (Pinus rigida). The average height of the barrens vegetation varies from knee-high in years following intense burns to about five meters (16ft). Compositionally and environmentally, the Central Appalachian "pine barrens" can be considered part of the Pine – Oak / Heath Woodlands ecological group, but more study is needed to determine whether the Virginia stand represents a distinct community type (VA Nat Her 2007).

Disturbance Description

Fire regime group V, any severity 200yrs+. These stands could have burned when fuel accumulations caused by extended drought and beetle kill created fuel continuity conditions favorable for fire spread. Lightning strikes on the ridgetops are probable ignition sources. These stands are surrounded by mixed oaks that may have burned more frequently, however, fire only reached the pine stands under severe burning conditions. The rocky terrain inhibited surface fires from the oak forests from reaching the pine forests.

Periodic fire is an important ecological process that provides opportunities for regeneration of both pines and less competitive herbaceous species, while setting back successional encroachment of potential overstory oaks (especially chestnut oak). On cliffs and other very rocky sites, the vegetation is self-perpetuating due to extreme edaphic conditions.(VA Nat Her 2007).

Kind of disturbance that favors creation and maintenance of bear oak – pitch pine is one that kills aboveground portions of oak and that recurs at frequent but not necessarily regular intervals. Fire is most common disturbance type, but frost pockets and late spring frosts documented as an ecological factor in PA. If disturbances occur very frequently (very 2 – 3yrs) bear oak tend to be replaced by more resistant vegetation – low shrubs, grasses, ferns, other herbs. If disturbances infrequent, associated trees outgrow bear oak, which is shade intolerant and gets overtopped. Pitch pine disturbance: fire produces basal sprouts, bole and crown sprouts, mostly one severe fire followed by longer non- fire period (SAF 1980)

Adjacency or Identification Concerns

The Southern Appalachian Montane Pine Forest and Woodland, BpS 1352, is similar, but is geographically separated and characterized by Pinus pungens. Stands of this system (BpS 1377 -- Central Appalachain Pine-Oak Rocky Woodland) are often immediately adjacent to stands of the Central Appalachian Dry Oak-Pine Forest, BpS 1369. There is variabilty within this system related to dominant pine species, aspect, and physiognomy (woodland vs. forest, pygmy vs. tall). This model was developed to approximte the most abundant expression within this map zone (P. rigida, P. pungens woodland to open forest).

NatureServe (2007) notes that the northern extent of this system (BpS 1377) in central New England may overlap with Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571), which has Picea spp. prominent.

Native Uncharacteristic Conditions

Scale Description

Patch sizes can range from a few acres to 300ac+, but typically range from 1-50ac. It is usually a small patch occurrence.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Issues/Problems

Timber values on these sites are typically low, resulting in these areas being set aside for other uses (i.e. recreational sites, nature preserves, and second home development).

Fire reduction and the native insect pest, southern pine beetle (Dendroctonus frontalis) are the most serious threats to communities of this group, although historically, pine beetle-induced mortality followed by stand-replacing fire was a principal mechanism for pine regeneration (Va Nat Her 2007).

Comments

Suggested reviewer -- Mark Hall, Ecologist, NatureServe

Vegetation Classes

Class A 2 %

Early Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 1

Indicator Species* and Canopy Position

PINUS	Lower
QUERC	Lower
GABA	Lower
	All

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	20 %
Height	Shrub 0m	Shrub 0.5m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 0-10yrs); early development, open canopy. This seral stage is characterized by lichens, polytrichum, pine seedlings, oak seedlings and shrub seedlings. The soil surface is mostly bare with exposed rock surfaces and rocks, and scree cobbles, some of which were created by long-duration burning of lightered tree debris. Bare sand provides germination sites. This stage occurs with new site creation, i.e. rockfalls, slips, and other geologic events. Most typically, this stage occurs after severe stand replacement fire. The remaining root stocks of scrub oak and blueberry will exhibit sprouting. Recruitment of other species comes via animal and bird deposition from other sites, or any seed bank that was not consumed. This stage is not very common.

Class B 8 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Indicator Species* and Canopy Position

PINUS	Upper
QUERC	Low-Mid
QUIL	Lower
GABA	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	50 %
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform.

The dominant life form is the shrub layer of scrub oak and black huckleberry.

Description

(Class age = 11-39yrs). Early-development, open canopy. In this stage the pines have grown taller than the blueberries and scrub oaks. Differentiation of community structure is evident. Oaks, blackgum, and sweet birch are established (0.6 - 3ft) in the stand. The shrub layer is becoming well developed with spreading crowns. Surface and mixed fires may occur. Surface fire will retain the class. Mixed fire will revert the class to class A. Lightning strikes are the most probable source of ignition.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class C 74 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 6

Indicator Species* and Canopy Position

PINUS	Upper
QUERC	Mid-Upper
NYSY	Low-Mid
BELE	Low-Mid

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	80 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 40-250yrs). Late-seral stage, canopy closed in patches, pine with oak or other hardwood in overstory. Birch, white pine, and blackgum are common in the sub-canopy. Mountain laurel and/or other woody species and shrubs create a dense shrub layer. Gaps from overstory mortality due to drought and pine beetles are common. The stand has accumulated enough fuel to carry a lightning strike fire. Fires occurring in this class are mixed and replacement fires with mortality dependent on fire intensity, seasonality, and fuel loading. Mixed fires would move the stand to class D by reducing the shrub layer and killing the thin-barked white pine, birch, and blackgum. Stand-replacement fires would set the stand back to A. Total pine mortality from severe pine bark beetle outbreaks will decimate the system as the hardwoods replace the canopy gaps and prevent pine recruitment.

Class D 16 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 12

Indicator Species* and Canopy Position

PINUS	Upper
QUIL	Lower
GABA	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	21 %	50 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 40yrs+). This class has experienced the effects of pine bark beetle mortality, drought effects, and/or mixed fires, and natural ageing. Without fire, this stand reverts to class C via recruitment of the hardwood from seed dispersers and coppice sprouts. Mixed fire retains the class, replacement fire reverts the class to A.

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

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Fire Regime Group:** III

Historical Fire Size (acres)

Avg
Min
Max

Sources of Fire Regime Data

- ☐ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	397.4			0.00252	47
Mixed	374.6			0.00267	49
Surface	4541			0.00022	4
All Fires	185			0.00541	

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

References

Brooks, A.B. 1910. West Virginia Geological Survey. Vol 5. Forestry and Wood Industries, Acme Publishing, Morgantown, WV.

Hall, M. 200x. Unpublished thesis. Western Carolina University, Cullowhee, NC. (Community classification of Short Mountain WMA), West Virginia.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 08 June 2007.

Eyre, F. H. (ed). 1980. Forest Cover Types of the United States and Canada. Society of American Foresters, Washington, DC. 148p.

Virginia Natural Heritage Program. 2007. Pine-oak heath woodlands. Department of Conservation and Recreation. www.dcr.virginia.gov/natural_heritage.
See Vanderhosrt for pine references.

West Virginia Natural Heritage Program. 2007. Plots2-WV. Database System for West Virginia.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5714140 Southern Appalachian Grass and Shrub Bald

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

General Information

Contributors (also see the Comments field) **Date** 10/12/2007

Modeler 1	Carl Nordman	carl_nordman@naturereserve.org	**Reviewer**
Modeler 2			**Reviewer**
Modeler 3			**Reviewer**

Vegetation Type

Upland Grassland/Herbaceous

Dominant Species*

DACO PIRU
RHCA8 QURU
CRATA
RUBUS

General Model Sources

☑ Literature
☐ Local Data
☑ Expert Estimate

Map Zone

57

Model Zone

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

Geographic Range

On high Southern Appalachian mountains, from 4600-6100ft (1415-1875m) elevation, with most examples from 5200-5800ft (1600-1780m) elevation (Mark 1958).

Biophysical Site Description

Heath balds could be mapped separately from grassy balds following the approach used in White et. al. (2001) -- The distribution of heath balds in the Great Smoky Mountains. The distribution and classification of grassy balds (by presumed origin) is best documented in Gersmehl, P. (1970) -- A geographic approach to a vegetation problem: The case of the southern Appalachian grassy balds. Many of the current and historic balds are known to have been created by white settlers for high elevation pasture. These are not the subject of this VDDT model, which is intended to model the presettlement landscape.

Vegetation Description

This ecological system consists of dense herbaceous and shrubland communities in the highest elevational zone of the southern Appalachians, generally above 1524m (5000ft) but occasionally to 1220m (4000ft), and at slightly lower elevations at its northern limit in VA and WV, and in the Cumberland Mountains along the VA-KY border. Vegetation consists either of dense shrub-dominated areas (heath balds) or dense herbaceous cover dominated by grasses or sedges (grassy balds). The combination of high-elevation, non-wetland sites and dense herbaceous or shrub vegetation without appreciable rock outcrop conceptually distinguishes this system from all others in the southern Appalachians. However, widespread areas of degraded spruce-fir with grass and shrub cover and the invasion of grassy balds by trees blur the distinction somewhat. The presence of species characteristic of the southern Appalachians, such as Menziesia pilosa, Saxifraga michauxii and Paronychia argyrocoma, distinguish this system from outcrop

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

systems to the north (e.g., Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571)) (NatureServe 2007).

Disturbance Description

Sites may be disturbed by grazing, wind/weather and fire. Native grazing in the presettlement landscape was replaced by grazing of domesticated livestock by white settlers. Fire in grass balds can destabilize a persistent herbaceous cover by opening up the duff or thatch under the grass or sedge mat and promoting germination of woody plant seeds (Chris Ulrey, pers. comm.). In this sense, the role of fire in the grass bald may be the opposite of what is typical in fire disturbed ecosystems.

Adjacency or Identification Concerns

Adjacent to high elevation red oak, northern hardwoods, beech gap or spruce fir forest.

Heath balds are abruptly bounded by much taller forests and thus are easily mapped.

Native Uncharacteristic Conditions

Grassy balds which have been open and historically and perhaps prehistorically grass (Danthonia compressa) or sedge (Carex spp.) dominated are becoming shrubby and then forested in the absence of grazing, especially since the 1930s. High atmospheric nitrogen deposition (from pollution) may also be influencing the vegetation dynamics of balds (Weiss 1999, Stevens et al 2004, and Nodvin et al 1995). This Nitrogen deposition is about the highest found in the United States. Nitrogen deposition, especially in combination with higher atmospheric CO2 concentrations and warmer winter temperatures may be driving a more rapid transition from the grassy balds (Class A) to the shrubby open condition (Class C) and from shrubby open to late development open (Class D) (Sturm et al 2005). The productivity of many ecosystems is Nitrogen limited, so the extended growing season and warmer temperatures associated with climate warming and the potential productivity gains from higher atmospheric CO2 availability are Nitrogen limited. In these high elevation systems, however the Nitrogen deposition may be facilitating higher productivity, which in the absence of grazing, speeds the transition from grassy to woody plant dominance. This may explain why the vegetation dynamics today is different from the modeled dynamics in pre-settlement times.

Scale Description

On Roan Mountain balds over 200ha. Elsewhere balds are much smaller, 1-8ha in the Great Smoky Mountains NP (White and Sutter, 1999).

Issues/Problems

Both grass balds occur on less than one percent of the sites suitable for them (White and Sutter, 1999) and heath balds occur on 4-9% of the sites suitable for them (White, Wilds & Stratton, 2001). Forests occur on most of these sites. The model approaches these numbers, but does not achieve the low percents from the literature. This should be taken into account in applying the VDDT model to the mapped distribution of BpS 1414.

Comments

Review for this model was not sought as C. Nordman spoke with many individuals in the creation of this model – essentially getting review in the process of its creation. C. Nordman contacted the following individuals who provided valuable feedback: Gary Kaufmann (USDA Forest Service), Nora Murdock (NPS- APHN), Jamey Donaldson, Andrea Bishop (Tennessee Div. of Natural Areas), Carolyn Wells (US FWS), Robert Sutter (TNC), Peter White (UNC-Chapel Hill), Chris Ulrey (NPS-BLRI), Michael Schafale (NC-NHP). Unfortunately, time did not allow for more discussion with Judy Murray (SAHC), Kris

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Johnson (NPS-GSMNP).

Vegetation Classes

Class A 5%

Early Development 1 All Structure

Upper Layer Lifeform

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

Fuel Model 5

Indicator Species* and Canopy Position

DACO	Lower
CAREX	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Herb 0m	Herb 0.5m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

(Class age 0-999yrs.). This is the grass bald. Vegetation is herbaceous graminoid, predominantly native grasses and sedges (Carex spp.). The graminoid vegetation is thick and there is a significant thatch or duff layer of grass between the actively growing green leaves and the soil surface. This thick dominance of grasses and sedges provides a competitive advantage to the graminoids, and limits the ability for woody plant seeds to germinate.

Grazing has kept these sites open in the period from European settlement until the first half of the 20th century when land managing agencies acquired lands and grazing ceased. Since that time shrubs and then trees have encroached into the grassy balds, with the loss of grassy balds due to the invasion by shrubs and trees at about 1-2%/year (Lindsay & Bratton 1980). There is little evidence of charcoal in the soil; fire is difficult to ignite in the moist environment and the effect of fire has not enhanced an open grassy condition in several management trials (Barden 1978, Lindsay & Bratton 1979, Murdock 1986, White & Sutter 1999). Association of grassy balds with native American use or the grazing of native large herbivores (Elk, Woodland Bison, and even Pleistocene megafauna) is a common factor in the explanation of the persistence of grassy balds in the pre-settlement landscape (Wells 1936, Wells 1937, Wiegl & Knowles 1999). This is incorporated into the VDDT model as lack of grazing (alternative succession) leading to class C.

Another factor in the distribution of the grassy balds is the association with high elevation springs (Wells 1936, Wells 1937) which could have attracted native grazers and native Americans, and were certainly an important factor in the selection of sites for livestock grazing by white settlers. Review Comments 11/07: When class C was changed from zero to one year, this created a new model rule violation as Replacement Fire in class A moves pixels to class C. Since this could only impact pixels at Time 0 in class A and the age advancement is only one year, we will leave that unchanged.

Class B 12%

Mid Development 1 Closed

Upper Layer Lifeform

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

Fuel Model 6

Indicator Species* and Canopy Position

RHCA8	Middle
RHMA4	Middle
RHMI2	Middle
KALA	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	100 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

(Class age 0-999yrs.). Heath bald, dominated by heath shrubs. Heath balds occur on 4-9% of the sites suitable for them (White, Wilds & Stratton 2001). These sites tend to have some fire influence, and are found on ridges and may have scattered trees. Some sites were logged in the first half of the 20th century, then burned in intense logging slash fires. In the absence of any disturbance for an extended period of time these balds may transition to either class D or class E.

"Heath balds are distinctive in structure and composition: they have a 1-2m tall evergreen canopy, deep leaf litter, very acidic A-horizons (Cain 1931), low species richness, and a mostly woody flora (ca. 15 woody species, 12 of which are in Ericaceae, and five herbaceous species; P. White unpubl.). Dominants include Rhododendron maximum, R. catawbiense, R. minus, Kalmia latifolia, and Leiophyllum buxifolium. Heath balds are abruptly bounded by much taller forests and thus are easily mapped. Comparison of selected heath balds on 1930s and 1980s aerial photographs showed no changes in area (P. White unpubl.); past studies have also treated these communities as stable (Whittaker 1956; Cain 1930b). There are almost no tree seedlings established in heath balds because of the dense evergreen canopy and the thick, acidic leaf litter. Productivity in heath balds is low (Whittaker 1961, 1962)." quoted from (White, Wilds & Stratton, 2001).

Class C **8 %**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 5

Indicator Species* and Canopy Position

CRATA	Middle
RUBUS	Middle
SOAM3	Middle
DACO	Lower

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	21 %	60 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 1-20yrs). Shrub bald or grassy bald encroached with shrubs. Shrubs and then trees have encroached into the grassy balds, the loss due to invasion by shrubs and trees ~1-2%/year (Lindsay & Bratton 1980, Lindsay & Bratton 1979). Alnus viridis ssp crispa represents a special case shrubland on Roan Mountain only, this class C is designed to cover the shrubs invading grassy balds at a variety of sites and might not work well for the Alnus viridis ssp crispa shrubland found on Roan Mountain. Review Comments 11/2007: To avoid having 2 seral stages with Age 0, changed class C from 0-20yrs to 1-20yrs [No significant impact on the model results].

Class D **8 %**

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Indicator Species* and Canopy Position

QURU	Upper
FAGR	Upper
PIRU	Upper
DACO	Lower

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	21 %	60 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 21-999yrs.). Open forest with a grassy understory along ridges or especially near trails on ridges (Wells, 1936). This vegetation is documented from the 1930s along the edges of grassy balds and trails near grassy balds (Wells 1936, Lindsay & Bratton 1979). Without grazing, closed forests have developed on these sites (see figure 9a (class D) and Figure 9b (class E) in Lindsay & Bratton 1979) -- this has been applied in

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

the VDDT model as a lack of grazing (alternative succession) towards class E. Option1 (human clearing) was used in the VDDT model to show the activities of Native Americans to use firewood for fuel at summer camps and to open areas to attract large game and improve hunting opportunities.

Class E **67 %**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PIRU	Upper
ABFR	Upper
QURU	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	100 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Largest red spruce 33.5m tall in Great Smoky Mountains National Park (Burns & Honkala 1990).

(Class age 0-999yrs). This closed forest is the dominant vegetation covering most of the land area in this model. The actual balds are sort of an anomaly in an otherwise forested landscape. Disturbances are infrequent. Option1 (human clearing) was used in the VDDT model to show the activities of Native Americans to use firewood for fuel at summer camps and to open areas to attract large game. Also fire and wind is a factor in opening up these forests (Ramseur 1976).

Disturbances

Fire Regime Group:** **III**

Historical Fire Size (acres)

Avg 4
Min 1
Max 200

Sources of Fire Regime Data

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	281.8			0.00355	55
Mixed	345.8			0.00289	45
Surface					
All Fires	155			0.00645	

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) Clearing by native Americans
- ☑ Wind/Weather/Stress
- ☐ Competition
- ☐ Other (optional 2)

References

Barden, L.S. 1978. Regrowth of shrubs in grassy balds of the southern Appalachians after prescibed burning. Castanea 43: 238-246.

Billings, W. D. and A. F. Mark. 1957. Factors involved in the persistence of montane treeless balds. Ecology 38(1): 140-142.

Brown, D. M. 1941. Vegetation of Roan Mountain: A phytosociological and successional study. Ecological

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Monographs 11: 61-97.

Bruhn, M. E. 1964. Vegetational succession on three grassy balds of the Great Smoky Mountains. M.S. thesis, Univ. of Tennessee, Knoxville. 84 pp.

Burns, Russell M. and Barbara H. Honkala, tech. coords. 1990. Silvics of North America: 1 Conifers. Agriculture Handbook 654. USDA Forest Service. Washington, DC.

Cain, S.A. 1930b. An ecological study of the heath balds of the Great Smoky Mountains. Butler University Botanical Studies 1(13): 176-208.

Camp, W. H. 1931. The grass balds of the Great Smoky Mountains of Tennessee and North Carolina. Ohio J. Sci. 31: 157-164.

Castro, P. K. 1969. A quantitative study of the subalpine forests of Roan and Bald Mountains in the Southern Appalachians. M.S. thesis, East Tennessee State Univ., Johnson City. 59 pp.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow and J. Teague. 2003. Ecological systems of the United States: A working classification of U.S. terrestrial systems. NatureServe, Arlington, VA.

DeSelm, H. R. and N. Murdock. 1993. Grass-dominated communities. Pages 87-141 in: W. H. Martin, S. G. Boyce and A. C. Echternacht, editors. Biodiversity of the southeastern United States: Upland terrestrial communities. John Wiley and Sons, New York.

Gant, R. E. 1978. The role of allelopathic interference in the maintenance of southern Appalachian heath balds. Ph.D. dissertation, University of Tennessee, Knoxville. 123 pp.

Gates, W. H. 1941. Observations on the possible origin of the balds of the Southern Appalachians. LA State Univ. Press, Baton Rouge, LA.

Gersmehl, P. J. 1969. A geographic evaluation of the ecotonal hypothesis of bald location in the Southern Appalachians. Proceedings of the American Society of Geographers 1: 51-54.

Gersmehl, P. 1970. A geographic approach to a vegetation problem: The case of the southern Appalachian grassy balds. Ph.D. dissertation, Univ. of Ga., Athens. 463 pp.

Gersmehl, P. J. 1971. Factors involved in the persistence of southern Appalachian treeless balds: An experimental study. Proceedings of the Association of American Geographers 3: 56-61.

Gersmehl, P. 1973. Pseudo-timberline: The southern Appalachian grassy balds. Arctic and Alpine Research 9:A137-A138.

Gilbert, V. C., Jr. 1954. Vegetation of the grassy balds of the Great Smoky Mountains National Park. M.S. thesis, Univ. of Tennessee, Knoxville.

Harmon, Mark. 1982. Fire History of the Westernmost Portion of Great Smoky Mountains National Park. Bulletin Torrey Botanical Club 109(1): 74-79.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Hayes, Matthew, Aaron Moody, Peter S. White and Jennifer L.Costanza. 2006. The influence of logging and topography on the distribution of spruce-fir forests near their Southern limits in Great Smoky Mountains National Park, USA. Plant Ecol (2007) 189: 59–70.

Knoepp, J. D., L. L. Tieszen and G. G. Fredlund. 1998. Assessing the vegetation history of three southern Appalachian balds through soil organic matter analysis. Research Paper SRS-13. USDA Forest Service, Southern Search Station, Asheville, NC. 12 pp.

Lindsay, M. 1976. History of the grassy balds of Great Smoky Mountains National Park. USDI National Park Service, Uplands Field Research Lab. Research/Resources Management Report No. 4. Gatlinburg, TN. 215 pp.

Lindsay, M. 1977. Management of grassy balds in Great Smoky Mountains National Park. USDI National Park Service, Southeast Region, Uplands Field Research Laboratory. Research/Resources Management Report No. 17. Gatlinburg, TN. 67 pp.

Lindsay, M. M. and S. P. Bratton. 1979b. The vegetation of grassy balds and other high elevation disturbed areas in the Great Smoky Mountains National Park. Bulletin of the Torrey Botanical Club 106: 264-275.

Lindsay, M. M. and S. P. Bratton. 1980. The rate of woody plant invasion on two grassy balds. Castanea 45: 75-87.

Lindsay, Mary M. and Susan Power Bratton. 1979. Grassy Balds of the Great Smoky Mountains: Their History and Flora in Relation to Potential Management. Environmental Management 3(5): 417-430.

Mark, A. F. 1958. The ecology of the southern Appalachian grass balds. Ecological Monographs 28: 293-336.

Mark, A. F. 1959. The flora of the grass balds and fields of the southern Appalachian Mountains. Castanea 24: 1-21.

McLeod, Donald Evans. 1988. Vegetation patterns, floristics, and environmental relationships in the Black and Craggy Mountains of North Carolina. Doctoral thesis, Botany Department, University of North Carolina at Chapel Hill.

Murdock, N. 1986. Evaluation of Management Techniques on a Southern Appalachian Bald. M.S. Thesis, Western Carolina University. Culowhee, NC.

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.2. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: November 2, 2007).

Nodvin, S.C., H. Van Miegroet, S.E. Lindberg, N.S. Nicholas and D.W.
Johnson. 1995. Acidic deposition, ecosystem processes, and nitrogen saturation in a high elevation Southern Appalachian Watershed. Water, Air
and Soil Pollution 85: 1647-1652.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Ramseur, G. S. 1958. The vascular flora of high mountain communities of the southern Appalachians. Ph.D. dissertation. University of North Carolina, Chapel Hill. 106 pp.

Ramseur, G.S. 1960. The vascular flora of high mountain communities of the southern Appalachians. J. Elisha Mitchell Science Society 76: 82-112.

Ramseur, G.S. 1976. Secondary succession in the spruce-fir forest of the great Smoky Mountains National Park. US Dept. Interior, National Park Service, Uplands Field Res. Lab. Management Report No. 7.

Shafer, D.S. 1986. Flat Laurel Gap Bog, Pisgah Ridge, North Carolina: Late Holocene development of a high-elevation heath bald. Castanea 51: 1-10.

Stevens, Carly J., Nancy B. Dise, J. Owne Mountford and David J. Gowing. 2004. Impact of Nitrogen Deposition on the Species Richness of Grasslands. Science 303(5665): 1876-1879.

Stratton, D. A. and P. S. White. 1982. Grassy balds of Great Smoky Mountains National Park: Vascular plant floristics, rare plant distributions, and an assessment of the floristic data base. USDI National Park Service, Southeast Region. Uplands Field Res

Sturm M, Schimel J, Mechaelson G,Welker JM, Oberbauer SF, et al. 2005. Winter biological processes could help convert Arctic tundra to shrubland. BioScience 55: 17–26.

Sullivan, J.H. and J.D. Pittillo. 1988. Succession of woody plants into a high elevation grassy bald of the Balsam Mountains. Castanea 53(4): 245-251.

Weiss, Stuart B. 1999. Cars, Cows, and Checkerspot Butterflies: Nitrogen Deposition and Management of Nutrient-Poor Grasslands for a Threatened Species. Conservation Biology 13(6): 1476-1486.

Wells, B.W. 1936. Andrews Bald: The problem of its origin. Castanea 1: 59-62.

Wells, B.W. 1936. Origin of the southern Appalachian grass balds. Sci. 83: 283.

Wells, B.W. 1937. Southern Appalachian grass balds. Journal of the Elisha Mitchel Scientific Society 53: 1-26.

Wells, B.W. 1961. The southern Appalachian grass bald problem. Castanea 26: 98-100.

White, Peter S. and Robert D. Sutter. 1999. Southern Appalachian grassy balds: lessons for management and regional conservation. In: Peine JD (ed.) Ecosystem manage-ment: principles and practices illustrated by a regional biosphere cooperative. St. Lucie Press, Delray Beach, Florida, pp 375-396

White, P. S., S. Wilds and D. A. Stratton 2001. The distribution of heath balds in the Great Smoky Mountains. Journal of Vegetation Science 12: 453-466.

Whittaker, R. H. 1979. Appalachian balds and other North American heathlands. Pages 427-439 in: R. L. Specht, editor. Ecosystems of the world. Series Publication 9A. Heathlands and related shrublands: Descriptive studies. Elsevier Scientific Publishing Co

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Wiegl, P. D. and T. W. Knowles. 1999. Antiquity of southern Appalachian grass balds: The role of keystone megaherbivores. Pages 215-223 in: R. P. Eckerlin, editor. Proceedings of the Appalachian Biogeography Symposium, Virginia Museum of Natural History.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5714710 Central Interior and Appalachian Floodplain Systems

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

General Information

Contributors (also see the Comments field **Date** 7/25/2007

Modeler 1	Doug Sprouse	doug.sprouse@ncmail.net	**Reviewer**	Carl Nordman	carl_nordman@natureserve.org
Modeler 2			**Reviewer**	Wayne Clatterbuck	wclatter@utk.edu
Modeler 3			**Reviewer**		

Vegetation Type
Wetlands/Riparian

Map Zone
57

Model Zone

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

Dominant Species*

PLOC	CELA
BENI	FAGR
ACRU	FRPE
LIST2	SANI

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
This systems group encompasses large-river floodplains over much of the eastern US, from southern New England south to GA, and west to the Dakotas and eastern Oklahoma (NatureServe 2007).

Biophysical Site Description
This systems group encompasses large-river floodplains over much of the eastern United States (NatureServe 2007), but differs from the Coastal Plain model in several ways. First it is floristically different in that it lacks cypress and tupelo except in its lowest elevation where it transitions to the Coastal Plain. Permanent standing water is lacking except in the areas closest to sea level where oxbow lakes may exist. Hydroperiods are shorter and fluvial features such as river terraces, oxbows, alluvial flats, point bars, streamside levees and other fine-scale alluvial floodplain features are abundant. NatureServe (2007) notes some will include herbaceous sloughs and shrub wetlands, particularly in abandoned channels

The substrate is primarily alluvium. The generally fertile soils are usually sandy to loamy but include local clayey and gravelly areas (NatureServe 2007).

Synonyms for this BpS and its variations include eastern riverfront forest, bottomland hardwood forest, and alluvial forest. Fire and beaver activity create a mosaic whose elements include canebrake, beaver ponds, and grass-sedge meadows in abandoned beaver clearings, as well as the swamps and bottomland hardwood forests that make up more than 95% of the cover that exists today.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Vegetation Description

Most of the system is forest vegetation. The canopy is usually dominated by a mix of characteristic alluvial and bottomland species (depending on the region) such as sycamore (Platanus occidentalis), river birch (Betula nigra), box elder (Acer negundo), eastern cottonwood (Populus deltoides), sugarberry (Celtis laevigata), green ash (Fraxinus pennsylvanica), sweetgum (Liquidambar styraciflua) and red maple (Acer rubrum). NatureServe (2007) also notes characteristic trees include silver maple (Acer saccharinum), willows, especially black willow (Salix nigra) in the wettest areas, American elm (Ulmus Americana), swamp chestnut oak (Quercus michauxii), cherrybark oak (Quercus pagoda), and, at least in the Midwest, bur oak (Quercus macrocarpa) in more well-drained areas. The particular mix of tree species will vary across the geographic range of this systems group, with some trees absent over parts of the range. Successional areas are often dominated by sweetgum (Liquidambar styraciflua), or tulip tree (Liriodendron tulipifera).

The driest and most fire sheltered sites support species such as pignut hickory (Carya glabra), shagbark hickory (Carya ovata), beech (Fagus grandifolia) and other fire sensitive species.
Subcanopy species included American holly (Ilex opaca), deciduous holly (Ilex decidua and Ilex ambigua), red mulberry (Morus rubra), ironwood (Carpinus caroliniana) and hop hornbeam (Ostrya virginiana). Shrubs such as spicebush (Lindera benzoin), beautyberry (Callicarpa americana), yellowroot (Xanthorhiza simplicissima), common buttonbush (Cephalanthus occidentalis), roughleaf dogwood (Cornus drummondii) and pawpaw (Asimina triloba); sedges (Carex spp.); and grasses including eastern bottlebrush grass (Elymus hystrix), Canada wildrye (Elymus Canadensis) and Indian woodoats (Chasmanthium latifolium) and false nettle (Boehmeria cylindrica) may be present.

Oxbows may support herbaceous vegetation dominated by species including Nelumbo lutea and Typha latifolia.

Frequently reworked gravel bars may be dominated by young black willow (Salix nigra), sycamore (Platanus occidentalis), or river birch (Betula nigra), or they may have sparse vegetation of a wide variety of annual and perennial herbs of weedy habits (NatureServe 2007).

There are numerous accounts of canebrake (Arundinaria gigantea ssp. gigantea) in piedmont bottomlands, both as historical accounts and on deed descriptions (Frost 2005). Canebrake occurred in particular locations that had easy access for fire (i.e. bottomlands bordered by upland flats as opposed to steep slopes) and where the uplands experienced frequent fire as the result of a combination of lightning and Native American ignitions.

Natural levee forests form on ridges of silt and sand deposited on stream margins during flood conditions. A levee's width is related to the abundance of ground vegetation present to re-enforce sediment in future deposition events. They receive more light and may be dominated by stream margin specialists such as sycamore (Platanus occidentalis), willows (Salix nigra), river birch (Betula nigra), box elder (Acer negundo) and Eastern cottonwood (Populus deltoides). Streamside levees are typical habitat for river oats (Chasmanthium latifolium) and a diverse flora of other bottomland graminoids and forbs.

Because of the particular mix and diversity of tree species will vary across the geographic range of this systems group, the list of BpS dominant and indicator species is only a rudimentary list.

Disturbance Description

Fire regime group III (conspicuous and most frequent in stands with canebrake or native grassy

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

understory). Fire return interval varied highly. Except in canebrake, most fires were very light surface fires, creeping in hardwood litter with some thin, patchy cover of bottomland grasses such as slender woodoats (Chasmanthium laxum) and river oats (Uniola latifolia). Flame lengths were mostly 6 to 12 inches. Even so, fire-scarred trees can be found in most bottomlands except in the wettest microsites. Stand replacement fires are unknown in this type. Except where Native American burning was involved, fires likely occurred primarily during drought conditions and then often only when fire spread into bottomlands from more pyrophytic uplands. Trees may be partially girdled by fire in duff, followed by bark sloughing. While fire rarely killed the tree, this allowed entry of rot, which, in the moist environment, often resulted in hollow trees, providing nesting and denning habitat for many species of birds and animals. Surface fires occurred on a frequency ranging from about 3-8yrs in canebrake and bottomland hardwood/canebrake, to 25yrs or more in hardwood litter. Low areas having a long hydroperiod, islands, and areas protected from fire by back swamps and oxbows were virtually fire free. Fire effects were largely limited to top kill of shrubs and tree saplings less than 2 inches diameter, and formation of hollow trees.

Other Disturbance Types. The distinctive dynamics of river flooding are presumably the primary reason for the distinctive vegetation of this system, though not all of the factors are well known. The large rivers have the largest watersheds in the region, but the gradients of most of these rivers limit floods to fairly short duration. Flooding is most common in the winter, but may occur in other seasons. The sorting of plant communities by depositional landforms of different height suggest that wetness or depth of flood waters may be of significance, though it has much less
influence than in the Coastal Plain. Flood waters have significant energy, and scouring and reworking of sediment are an important factor in bar and bank communities. In addition to disturbance, floods bring nutrient input, deposit sediment, and disperse plant seeds. While flooding rarely leads to canopy tree mortality except where beavers impounded a channel or along stream banks where a tree might be subject to undercutting in the process of channel migration, the most significant disturbance in bottomlands was wind.

Winds have a major affect in bottomland forests because of wet soils, less dense soil, and trees that are shallow-rooted. Like all but a few Eastern forest types, canopy tree mortality was limited to tree by tree or small group replacement and wind throw was the primary cause of mortality in bottomlands. The frequency of these events equates with major hurricanes (East of the Mountains predominantly), occurring at approximately 20yr intervals. While tornado tracks can be found passing across uplands and bottomlands (see one such indicated on a map of Umstead State Park, Raleigh, North Carolina), leaving narrow swaths of felled trees, the majority of wind throw seems to have been the result of hurricanes and hurricane-spawned tornadoes. Following Hurricane Fran in 1996, even though the Piedmont is removed from the coast by 25 to over 100 miles, there was extensive wind throw of middle-aged and old growth trees in Piedmont bottomlands. Bottomland oaks, even though seemingly more sheltered, were much more heavily affected than hardwoods on adjacent uplands. Gaps as large as 1 hectare were seen intermixed in areas with extensive single tree wind throw. Note that tornados can be common outside hurricane events in some regions.

Adjacency or Identification Concerns

Compare to Southern Flood Plain model for the Atlantic and Gulf coastal plain variant of this type. This more upland type is characterized by narrower floodplains and vegetation adapted to varying levels of inundation, but less long term flooding and permanent standing water, although species including bald cypress (Taxodium distichum) and gums such as tupelo (Nyssa aquatica), swamp black gum (Nyssa biflora) occur in areas adjacent to the coastal plain with longer regular inundation periods. Piedmont and mountain river floodplain forests are differentiated from adjacent mesophytic upland forests (see Rapid

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Assessment model R8MMHF, Mixed Mesic Hardwoods Forest) by the presence of plants indicative of alluvial or bottomland settings such a sycamore (Platanus occidentalis), river birch (Betula nigra), and box elder (Acer negundo). These bottomlands often allow drier-associated species such as oaks and pines to encroach during droughty periods, and then persist due to the lack of long-term inundation in steeper, narrower floodplains.

Standard Ecological Systems noted by NatureServe (2007) that make up this aggregated system include:
- Central Appalachian River Floodplain (CES202.608)
- North-Central Interior Floodplain (CES202.694)
- South-Central Interior Large Floodplain (CES202.705)
- Southern Piedmont Large Floodplain Forest (CES202.324)

Native Uncharacteristic Conditions

Scale Description

Narrow bands or isolated pockets are found along river and stream bottoms (quarter mile from stream, largely dependent upon nearby topography). Larger homogenous areas found in level or slightly rolling landscapes adequate in size to contain natural variation in vegetation and disturbance regime. (>5000ac).

Issues/Problems

Federal reservoirs have had a serious and negative effect, along with agriculture that has converted much floodplain acreage to drained agricultural land. In the remaining less altered floodplains, flood duration varies according to the river's gradient (NatureServe 2007).

Comments

This model, as described for MZ54 and MZ59, was adopted from BpS 1473 for Gulf and Atlantic Coastal Floodplain, and the Rapid Assesment model R8FPFOpi -- Bottomland Hardwood Forest. All relevant reference documents were left from R8FPFOpi that were mainly used in the General and Class descriptions. The VDDT model was adopted from R8FPFOpi and a few class probabilistic transitions were changed or added.

Vegetation Classes

Class A **9%**

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

ACRU	All
LIST2	All
FRPE	All

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	60 %
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 0-19yrs). Tree fall gaps and other replacement disturbance areas 0-19yrs in age with saplings and small trees up to 30cm DBH. Potential canopy species are typically mixed with subcanopy species and herbs, and an occasional stem of a short-lived early successional species such as willow (Salix nigra). This class succeeds to Box B (Mid Closed) at 20yrs.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class B 25 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

ACRU	Upper
LIST2	Upper
BENI	Upper
CELA	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	81 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 20-69yrs). Old tree fall gaps and replacement disturbance with closed canopy 20-69yrs in age, ranging from 30-70cm DBH. Shade tolerant species in the understory. This class succeeds to Box E (Late Closed) at 70yrs. Replacement fire is rare (500yrs) and returns this class to A. Wind Events (100yrs) move this class to Box C. Scouring flood event returns this class to Box A (300yrs.) Surface fire (200yr) and Mixed Fire (500yr) opens this class to C.

Class C 6 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PLOC	Upper
CELA	Upper
FAGR	Upper
BENI	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	80 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 20-69yrs). Similar overstory as class B but more open,without a well-developed midstory or understory. Grasses will also be present. This class succeeds to Box D (Late Open) at 70yrs. Surface Fire (100yrs) maintains this class. Wind events (150yrs) maintain this class. This class can succeed back to B (Mid Closed) without fire. Scouring flood events, and inundation (300yrs) will return this class back to A.

Class D 12 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PLOC	Upper
CELA	Upper
FAGR	Upper
BENI	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	80 %
Height	Tree 25.1m	Tree >50.1m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age = 70-500yrs). More of a closed canopy then class C with trees ranging from 70-300yrs+ in age with minimal midstory and understory shrubs and grasses. More shrubs and less grass than C. This class remains in a Late Open state at 500yrs and can succeed to Box E (late Closed) without fire. Surface fire (100yrs) and wind events (150yrs) maintain this class. Flooding (300yrs) returns this class to box A. Insect and disease kills (200yrs) will maintain this class.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Class E **48 %**

Late Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

PLOC	Upper
CELA	Upper
FAGR	Upper
BENI	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	81 %	100 %
Height	Tree 25.1m	Tree >50.1m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

(Class age 70-500yrs). Closed hardwood canopy with trees ranging from 70-300yrs+ in age. Extensive shade tolerant shrub understory and midstory. This Class remains Late Closed at 500yrs. Wind events (150yrs) will open this class to box D. Insect and Disease Kills (200yrs) will maintain this class. Rare mixed fire (300yrs) will open this class to D. Scouring floods and inundation (300yrs) will return this class to box A. Rare replacement fire (500yrs) will return this class to box A. Surface fire (100yrs) will maintain this class.

Disturbances

Fire Regime Group:** **III**

Historical Fire Size (acres)

Avg 1500
Min 10
Max 3000

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	612.5	200	1000	0.00163	13
Mixed	386.8	150	500	0.00259	21
Surface	121.3	4	200	0.00824	66
All Fires	80			0.01246	

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
☑ Wind/Weather/Stress
☐ Native Grazing
☐ Competition
☑ Other (optional 1) flooding
☐ Other (optional 2)

References

Barden, L.S. 1997. Historic prairies in the piedmont of North and South Carolina, USA. Natural Areas Journal 17: 149-152.

Batista, W.B. and W.J. Platt. 2003. Tree population responses to hurricane disturbance: syndromes in a south-eastern USA old-growth forest. Journal of Ecology 91: 197-212.

Brody, M., W. Conner, L. Pearlstine and W. Kitchens. 1989. Pgs. 991-1004 in Sharitz, R.R. and J.W. Gibbons (eds). Freshwater wetlands and wildlife: DOE symposium series No. 61. USDOE Office of Scientific and Technical Information, Oak Ridge, Tennessee.

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.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Devall, M. S. 1998. An interim old-growth definition for cypress-tupelo communities in the Southeast. USDA Forest Service GTR-SRS 19.

Ewel, K.C. 1995. Fire in cypress swamps in the southeastern United States. Pages 111-116 in Cerulean, S. I. and R. T. Engstrom (eds.). TTRS Fire Ecology Conference Proceedings. Tall Timbers Research, Inc., Tallahassee, FL.

Frost, Cecil C. 2005 (in prep). Presettlement vegetation and natural fire regimes of the Sumter National Forest, South Carolina. Report to the USDA Forest Service, Columbia, SC [with 2 GIS maps].

Frost, Cecil C. 1995. Presettlement fire regimes in southeastern marshes, peatlands and swamps. Pages 39-60 in Susan I. Cerulean and R. Todd Engstrom, eds. Fire in wetlands: a management perspective. Proc. Tall Timbers Fire Ecol. Conf. No. 19.

Harvesting Impacts on Bottomland Hardwood Ecosystems. 1997. Edited by J.A. Stanturf and M.G. Messina In Forest Ecology and Management 90(2-3): 93-252 (February 1997).

Hodges, J.D. 1997. Development and ecology of bottomland hardwood sites. Forest Ecology and Management 90(2-3): 117-125.

Jones, R.H. and R.R. Sharitz. 1990. Dynamics of advance regeneration in four South Carolina bottomland hardwood forests. Pgs. 567-578 in Sixth Biennial Southern Silvicultural Research Conference, Memphis, TN, Oct. 30-Nov. 1, 1990.

Kaufert, F.H. 1933. Fire and decay injury in the southern bottomland hardwoods. Journal of Forestry 31: 64-67.

Kellison, R.C. and M.J. Young. 1997. The bottomland hardwood forest of the southern United States. Forest Ecology and Management 90 (2-3): 101-115.

Kennedy, H.E. and G.J. Nowacki. 1997. An old-growth definition for seasonally wet oak hardwood woodlands. USDA Forest Service GTR SRS-8.

Lederer, John, 1672 [1966] The Discoveries of John Lederer, translated by Sir William Talbot, Readex Microprint, 1966.

Lentz, G.H. 1931. Forest fires in the Mississippi bottomlands. Journal of Forestry 29: 831-832.

Lockaby, B.G., J.A. Stanturf and M.G. Messina. 1997. Effects of silvicultural activity on ecological processes in floodplain forests of the southern United States: a review of existing reports. Forest Ecology and Management 90 (2-3): 93-100.

Logan, John H. 1859. A history of the upper country of South Carolina. Vol. I (Vol. II never pub.) S.G. Courtenay & Co., Charleston, S.C. 521 pp.

McWilliams, W.H. and J. F. Rosson, Jr. 1990. composition and vulnerability of bottomland hardwood forests of the Coastal Plain Province in the south central United States. Forest Ecology and Management 33: 485-501.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Monk, C. D., D. W. Imm, R. L. Potter and G. G. Parker. 1989. A classification of the deciduous forest of eastern North America. Vegetation 80: 167-181.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 15 April 2007.

Palik, B.J., J.C. Zasada and C.W. Hedman. Chapter 14. Ecological principles for riparian Silviculture. In: Riparian management in forests of the continental Eastern United States. E.S. Verry, J.W. Hornbeck and C.A. Dolloff (editors). Lewis Publishers.

Runkle, J.R. 1981. Gap regeneration in some old-growth forests of the eastern United States. Ecology 62: 1041-1051.

Schmidt, Kirsten M, Menakis, James P., Hardy, Colin C., Hann, Wendel J., Bunnell, David L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 pp. + CD.

Sharitz, R.R. and W.J. Mitsch. 1993. Southern floodplain forests. Pgs. 311-371 in W.H. Martin, S.G. Boyce and A.C. Echternacht (eds). Biodiversity of the Southeastern United States. John Wiley and Sons, New York.

Smith, L. 1988. The natural communities of Louisiana. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA.

Tanner, J.T. Distribution of tree species in Louisiana bottomland forests. Castanea 51: 168-174.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/.

Wharton, C.H. 1989. The natural environments of Georgia. Georgia Department of Natural Resources, Environmental Protection Division, Atlanta, Georgia.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

LANDFIRE Biophysical Setting Model

Biophysical Setting 5714720 Central Interior and Appalachian Riparian Systems

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

General Information

Contributors (also see the Comments field **Date** 7/25/2007

Modeler 1	Matt Barker	matthew.barker@ncmail.net	**Reviewer**	Jerre Creighton	jerre.creighton@dof.virginia.gov
Modeler 2	Eddie Reese	eddie.reese@ncmail.net	**Reviewer**	Wayne Clatterbuck	wclatter@utk.edu
Modeler 3	Colleen Ryan	colleenryan@post.harvard.edu	**Reviewer**		

Vegetation Type
Wetlands/Riparian

Map Zone
57

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

Dominant Species*

PLOC	CELA
BENI	LIQUI
ACNE2	FRPE
ACRU	LIRIO

General Model Sources
☐ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range

This systems group encompasses small stream riparian systems over much of the eastern US, from southern New England south to GA, and west to IL and eastern OK (NatureServe 2007).

Occurs near small streams and includes adjoining floodplains, terraces, and lower slopes affected by small stream flooding. This model encompasses the small stream forests of the Piedmont and Southern Appalachian regions. It does not include the broad vegetated floodplains of these and similar large, low gradient rivers and immediate tributaries, nor the high gradient, narrow small streams of the Appalachian mountains.

NatureServe (2007) describes this as an aggregated system including the following standard ecological systems:
• Central Appalachian Stream and Riparian (CES202.609)
• Cumberland Riverscour (CES202.036)
• Ozark-Ouachita Riparian (CES202.703)
• South-Central Interior Small Stream and Riparian (CES202.706)
• Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

Biophysical Site Description

These riverscour-influenced systems occur on moderately to very high-gradient streams over a wide range of elevations. It develops on small floodplains and shores along river channels that lack a broad, flat

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

floodplain due to steeper sideslopes, higher gradient, or both (NatureServe 2007).

The fluvial features (river terraces, oxbows, alluvial flats, point bars, and streamside levees) typical of river floodplains occur less frequently and on a smaller scale along these small streams. Fine-scale alluvial floodplain features are abundant. In pre-European settlement forests, community diversity in these streamside systems was much more complex than in the modified landscapes of today. Fire, beaver activity, and flooding of varied intensity and frequency created a mosaic whose elements included canebrake, grass and young birch / sycamore beds on reworked gravel or sand bars, beaver ponds, and grass-sedge meadows in abandoned beaver clearings, as well as the streamside zones and mixed hardwood and/or pine forests that make up more than 95% of the cover that exists today.

These systems have little to no floodplain development (i.e., floodplains, if present, are not differentiated into levees, sloughs, ridges, terraces, and abandoned channel segments) and are typically higher gradient than larger floodplains, experiencing periodic, strong flooding of short duration (NatureServe 2007).

Vegetation Description

Most of the system is forest vegetation. The succession of woody plants (particularly trees) is retarded by the force of "flashy," high-velocity water traveling down the stream channels (NatureServe 2007). The canopy is usually dominated by hardwoods, with pines a small component. Species may include sycamore (Platanus occidentalis), river birch (Betula nigra), box elder (Acer negundo), eastern cottonwood (Populus deltoides), sugarberry (Celtis laevigata), green ash (Fraxinus pennsylvanica), sweetgum (Liquidambar styraciflua), red maple (Acer rubrum), Swamp Chestnut Oak (Quercus michauxii), Cherrybark Oak (Quercus pagoda), hackberry (Celtis occidentalis), hemlock (Tsuga Canadensis) or pines (Pinus spp).

Successional areas of zones 54/59 are often dominated by sweetgum (Liquidambar styraciflua), or yellow poplar (Liriodendron tulipifera) whereas the mapzones of 53, 57, 61, 62 are often dominated by sycamore (Platanus occidentalis) or box elder (Acer negundo). Pines may be a larger component in the southern part of MZ54.

Sub-canopy species included American holly (Ilex opaca), deciduous holly (Ilex decidua and Ilex ambigua), red mulberry (Morus rubra), ironwood (Carpinus caroliniana) and hop hornbeam (Ostrya virginiana). Shrubs such as spicebush (Lindera benzoin), beautyberry (Callicarpa americana) and yellowroot (Xanthorhiza simplicissima); cane (Arundenaria gigantea) and other grasses; and false nettle (Boehmeria cylindrica) may be present. Caric sedges may dominate some areas.

NatureServe (2007) also notes the following common shrubs, occurring as forest/woodland understory or as non-forested shrublands: hazel alder (Alnus serrulata), common buttonbush (Cephalanthus occidentalis), silky dogwood (Cornus amomum), coastal plain willow (Salix caroliniana) and other Salix spp., eastern poison ivy (Toxicodendron radicans), and, over parts of the range, mountain witchalder (Fothergilla major), Virginia sweetspire (Itea virginica) and smooth azalea (Rhododendron arborescens). More southern examples may contain oakleaf hydrangea (Hydrangea quercifolia), bushy St. John’s wart (Hypericum densiflorum) and wax myrtle (Morella cerifera). Ozark witchhazel (Hamamelis vernalis) is characteristic in the Ozark/Ouachita region.

Forbs are diverse and variable from occurrence to occurrence. Some characteristic forbs are Baptisia australis, Conoclinium coelestinum (= Eupatorium coelestinum), Coreopsis pubescens, Coreopsis tripteris, Elephantopus carolinianus, Helenium autumnale, Hydrocotyle sp., Ludwigia leptocarpa, Lycopus spp., Orontium aquaticum, Osmunda regalis var. spectabilis, Oxypolis rigidior, Phlox carolina,

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Pityopsis graminifolia var. latifolia, Rudbeckia laciniata and Vernonia gigantean (NatureServe 2007).

Periodically reworked gravel bars may be dominated by young black willow (Salix nigra), sycamore (Platanus occidentalis), or infrequently river birch (Betula nigra), or they may have sparse vegetation of a wide variety of annual and perennial herbs of weedy habits.

Canebrakes occurred in particular locations that had easy access for fire (i.e. bottomlands bordered by upland flats as opposed to steep slopes) and where the uplands experienced frequent fire as the result of a combination of lightning and Native American ignitions.

Natural levee forests form on ridges of silt and sand deposited on stream margins during flood conditions. A levee's width is related to the abundance of ground vegetation present to re-enforce sediment in future deposition events. They receive more light and may be dominated by stream margin specialists such as sycamore (Platanus occidentalis), willows (Salix nigra), river birch (Betula nigra), box elder (Acer negundo) and eastern cottonwood (Populus deltoides). Streamside levees support a diverse flora of other bottomland graminoids and forbs.

Open, flood-scoured rivershore prairies feature Andropogon gerardii, Sorghastrum nutans, Schizachyrium scoparium,Chasmanthium latifolium, Tripsacum dactyloides and/or Panicum virgatum. Carex torta is typical of wetter areas near the channel (NatureServe 2007).

Distinctive shoals with Hymenocallis coronaria and/or Justicia americana may be present as well. Small seeps and fens can often be found within these habitats, especially at the headwaters and terraces of streams. These areas are typically dominated by primarily wetland obligate species of sedges (Carex spp.), ferns (Osmunda spp.) and other herbaceous species such as Impatiens capensis (NatureServe 2007).

Creighton also suggests silver maple (Acer saccharinum), common hackberry (Celtis occidentalis), spicebush (Lindera) and eastern hemlock (Tsuga canadensis) as dominant indicator species for mapzones 53, 57, 61, 62.

Disturbance Description

Flooding -- Flooding is the major process affecting the vegetation, with the substrate more rapidly drained than in flat floodplain areas. The distinctive dynamics of stream flooding and protected topographic position dominate the forming of the distinctive vegetation of this system. Not all of the factors are well known. Gradients of most of these rivers limit floods to fairly short duration. Flooding is most common in the winter, but may occur in other seasons particularly in association with hurricanes, tornados, or microbursts from thunderstorms. The sorting of plant communities by depositional landforms of different height suggest that wetness or depth of flood waters has significance. Flood waters have significant energy. Scouring and reworking of sediment make up an important factor in bar and bank communities. In addition to disturbance, floods bring nutrient input, deposit sediment, and disperse plant seeds. Most floods do not lead to canopy tree mortality. Flooding can act as a replacement disturbance in areas where beavers impounded a channel or in rare years with severe prolonged flood events. The most significant disturbance along small streams was wind. Two types of floods were modeled: occasional catastrophic floods due to beaver activity or other severe, prolonged floods, and more frequent repeated minor flooding (i.e., several minor floods within a 10yr period).

Winds affect streamside forests because of wet soils, less dense soil, and trees that are shallow-rooted. Canopy tree mortality from more common windstorms would have resulted in tree by tree or small group

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

replacement. Wind throw formed the primary cause of mortality in bottomlands. Major storms or even hurricanes occurring at approximately 20yr intervals would have impacted whole stands. Tornado tracks can be found passing across uplands and bottomlands (see one such indicated on a map of Umstead State Park, Raleigh, North Carolina), leaving narrow swaths of felled trees. The majority of wind throw in mapzones 54/59 seems to have been the result of hurricanes and hurricane-spawned tornadoes. Following Hurricane Fran in 1996, even though the Piedmont is removed from the coast by 25 to over 100 miles, extensive wind throw occurred in middle-aged and old growth trees in Piedmont bottomlands. Bottomland oaks, even though seemingly more sheltered, were much more heavily affected than hardwoods on adjacent uplands. Gaps as large as 1 hectare were seen intermixed in areas with extensive single tree wind throw. Windthrow may also occur because of thunderstorm microbursts or tornados.

Ice damage is an infrequent but potentially catastrophic disturbance, especially in Map zones 57 and 61 and the lower elevation portions of MZ59.

Fire -- Fire regime group III (conspicuous and most frequent in stands with canebrake). Fire return interval varied highly. Except in canebrake, most fires were very light surface fires, creeping in hardwood or pine litter with some thin, patchy cover of bottomland grasses. Flame lengths were mostly 6 to 12 inches. Even so, fire-scarred trees can be found in most small stream sites except in the wettest microsites. Stand replacement fires are almost unknown in this type. Except where Native American burning was involved, fires likely occurred primarily during drought conditions and then often only when fire spread into bottomlands from more pyrophytic uplands. Trees may be partially girdled by fire in duff, followed by bark sloughing. While fire rarely killed the tree, this allowed entry of rot, which, in the moist environment, often resulted in hollow trees, providing nesting and denning habitat for many species of birds and animals. Surface fires occurred on a frequency ranging from about 3-8yrs in streamside canebrake, streamside hardwood/canebrake, or pine, to 25yrs or more in hardwood litter. Low areas having a long hydroperiod, islands, and areas protected from fire by back swamps and oxbows were virtually fire free. Fire effects were largely limited to top kill of shrubs and tree saplings less than 2 inches diameter, and formation of hollow trees.

Adjacency or Identification Concerns

This Bps does not include the broad vegetated floodplains of these and similar large, low gradient rivers and immediate tributaries, nor the high gradient, narrow small streams of the Appalachian mountains. This BpS is likely to grade into 1471 (Central Interior and Appalachian Floodplain Systems).

NatureServe (2007) lists this as an aggregated system which includes the following standard ecological systems:

- Central Appalachian Stream and Riparian (CES202.609)
- Cumberland Riverscour (CES202.036)
- Ozark-Ouachita Riparian (CES202.703)
- South-Central Interior Small Stream and Riparian (CES202.706)
- Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

Native Uncharacteristic Conditions

Scale Description

Narrow bands or isolated pockets occur along small streams. Width depends strongly on topography.

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Issues/Problems

The widespread introduction of Chinese privet (Ligustrum sinense) and other invasives has dramatically reduced native diversity in the understory. Most occurrences of this system in North Carolina were cleared within the past century.

Widespread placement of dams has extensively altered flood frequency and duration in some areas.

Modelers are uncertain of the role of ice and the prevalence of pine in this system in Alabama and Georgia.

Comments

Barker, Reese and Ryan created this model based on BpS model 4614740 -- Gulf and Atlantic Coastal Plain Small Stream Riparian Systems, with substantial changes to the disturbance pathways. The modelers were most familiar with piedmont North Carolina and suggest review is needed for other areas, especially with respect to the Alabama and Georgia portions of MZ54. Literature listed is carried over from the previous model (BpS 4614740).

Subsequently, during the workshop for mapzones 53, 57, 61, and 62, Jerre Creighton (jerre.creighton@dof.virginia.gov) reviewed the Barker et al. model and had some species composition changes, but Creighton's model descriptions, class descriptions, class parameters (VDDT parameters) closely matched Barker et al. with slight changes to wind/weather/stress and options 1 & 2 frequencies. Barker et al. always gave wind/weather/stress a frequency of .005 (200yrs) and Options 1 & 2 frequencies of .003 (333yrs) and .01 (100yrs) respectively. Creighton changes the frequency of the wind/weather/stress events from class to class and Options 1&2 are given frequencies of .005 (200yrs) and .002 (500yrs).

However, the differences between the Creighton and Barker et al. model doesn't affect class percent outcome or fire frequency values. Both models are identical with an overall fire frequency of 169yrs.

Therefore, the BpS model descriptions provided were those of Barker et al. work with Creighton noted as a reviewer.

I would suggest however, that this model as combined by C. Szell be used for all mapzones listed.

Vegetation Classes

Class A 15 %

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

ACRU	All
LIST2	All
FRPE	All
LIRIO	All

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	60 %
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Tree fall gaps 0-19yrs in age with saplings and small trees up to 30cm DBH. Potential canopy species are typically mixed with subcanopy species and herbs, and an occasionally short-lived early successional species such as willow (Salix nigra) or river birch (Betula nigra). This can include areas disturbed by flooding from drained wetlands when beaver dams fail. Also included are other disturbed areas such as windthrow and

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

effects of tornados, hurricanes, thunderstorm microbursts, or ice events. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event once in 333yrs. Repeated minor flooding (Optional 2) that would open up the midstory would occur once in 100yrs. Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur once in 200yrs. Light, creeping surface fire is likely once in 200yrs. Replacement fire is likely only in extremely dry years (once in 1000yrs).

Creighton suggests the following indicator species for mapzones 53, 57, 61, 62:
Silver maple (Acer saccharinum), boxelder (Acer negundo), river birch (Betula nigra), and American Sycamore (Platanus occidentalis).

Class B **23 %**

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

ACRU	Upper
LIST2	Upper
BENI	Upper
CELA	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	71 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Old tree fall gaps and other disturbed areas with closed canopy 20-69yrs in age, ranging from 30-70cm DBH. Shade tolerant species in the understory. Occasionally with a pine dominated overstory. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event once in 333yrs. Repeated minor flooding (Optional 2) that would open up the midstory would occur once in 100yrs. Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur once in 200yrs. Light, creeping surface fire is likely once in 200yrs. Replacement fire is likely only in extremely dry years (once in 1000yrs).

Creighton suggests the following indicator species for mapzones 53, 57, 61, 62:
Silver maple (Acer saccharinum), boxelder (Acer negundo), river birch (Betula nigra), and American Sycamore (Platanus occidentalis).

Class C **13 %**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PLOC	Upper
CELA	Upper
FAGR	Upper
BENI	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	41 %	70 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Similar overstory as B but more open 20-69yrs in age but without well-developed midstory or understory. Grasses will also be present. Occasionally with a pine dominated overstory. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event once in 333yrs. Repeated minor flooding (Optional 2) that would open up the midstory would occur once in 100yrs (reversed in the VDDT model). Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur once in 200yrs. Light, creeping surface fire is likely once in 200yrs. Replacement fire is likely only in extremely dry years (once in 1000yrs).

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Creighton suggests the following indicator species for mapzones 53, 57, 61, 62:
Silver maple (Acer saccharinum), boxelder (Acer negundo), river birch (Betula nigra), and American Sycamore (Platanus occidentalis).

Class D **40 %**

Late Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PLOC	Upper
CELA	Upper
FAGR	Upper
BENI	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	41 %	70 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

More of a closed canopy then C with trees ranging from 70-300yrs+ in age with minimal midstory and understory shrubs and grasses. More shrubs and less grass than C. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event once in 333yrs. Repeated minor flooding (Optional 2) that would open up the midstory would occur once in 100yrs. Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur once in 200yrs. Light, creeping surface fire is likely once in 200yrs. Replacement fire is likely only in extremely dry years (once in 1000yrs).

Creighton suggests the following indicator species for mapzones 53, 57, 61, 62:
Silver maple (Acer saccharinum), black walnut (Juglans nigra), river birch (Betula nigra), and American Sycamore (Platanus occidentalis).

Class E **9 %**

Late Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 9

Indicator Species* and Canopy Position

PLOC	Upper
CELA	Upper
FAGR	Upper
BENI	Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	71 %	100 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Closed hardwood canopy with trees ranging from 70-300yrs+ in age. Extensive shade tolerant shrub understory and midstory. Major (stand-replacing) floods (Optional 1) would occur from beaver activity or a major storm event once in 333yrs. Repeated minor flooding (Optional 2) that would open up the midstory would occur once in 100yrs. Stand-replacing wind and/or ice damage (hurricanes, tornados, and ice storms) would occur once in 200yrs. Light, creeping surface fire is likely once in 200yrs. Replacement fire is likely only in extremely dry years (once in 1000yrs).

Creighton suggests the following indicator species for mapzones 53, 57, 61, 62:
Silver maple (Acer saccharinum), black walnut (Juglans nigra), river birch (Betula nigra), and American Sycamore (Platanus occidentalis).

Disturbances

---

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Fire Regime Group:** III

Historical Fire Size (acres)

Avg 200
Min 5
Max 3000

Sources of Fire Regime Data

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	996.6	200	1000	0.00100	17
Mixed		150	500		
Surface	200.7	50	250	0.00498	83
All Fires	167			0.006	

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
- [x] Other (optional 1) Major stand replacing floods
- [x] Wind/Weather/Stress
- [ ] Competition
- [x] Other (optional 2) repeated minor flooding

References

Batista, W.B. and W.J. Platt. 2003. Tree population responses to hurricane disturbance: syndromes in a south-eastern USA old-growth forest. Journal of Ecology 91: 197-212.

Brody, M., W. Conner, L. Pearlstine and W. Kitchens. 1989. Pgs. 991-1004 in Sharitz, R.R. and J.W. Gibbons (eds). Freshwater wetlands and wildlife: DOE symposium series No. 61. USDOE Office of Scientific and Technical Information, Oak Ridge, Tennessee.

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.

Devall, M. S. 1998. An interim old-growth definition for cypress-tupelo communities in the Southeast. USDA Forest Service GTR-SRS 19.

Ewel, K.C. 1995. Fire in cypress swamps in the southeastern United States. Pages 111-116 in Cerulean, S. I. and R. T. Engstrom (eds.) . TTRS Fire Ecology Conference Proceedings. Tall Timbers Research, Inc., Tallahassee, FL.

Frost, Cecil C. 2005 (in prep). Presettlement vegetation and natural fire regimes of the Sumter National Forest, South Carolina. Report to the USDA Forest Service, Columbia, SC [with 2 GIS maps].

Frost, Cecil C. 1995. Presettlement fire regimes in southeastern marshes, peatlands and swamps. Pages 39-60 in Susan I. Cerulean and R. Todd Engstrom, eds. Fire in wetlands: a management perspective. Proc. Tall Timbers Fire Ecol. Conf. No. 19.

Harvesting Impacts on Bottomland Hardwood Ecosystems. 1997. Edited by J.A. Stanturf and M.G. Messina In Forest Ecology and Management 90(2-3): 93-252 (February 1997) Hodges, J.D. 1997. Development and ecology of bottomland hardwood sites. Forest Ecology and Management 90(2-3): 117-125.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Jones, R.H. and R.R. Sharitz. 1990. Dynamics of advance regeneration in four South Carolina bottomland hardwood forests. Pgs. 567-578 in Sixth Biennial Southern Silvicultural Research Conference, Memphis, TN, Oct. 30-Nov. 1, 1990.

Kaufert, F.H. 1933. Fire and decay injury in the southern bottomland hardwoods. Journal of Forestry 31: 64-67.

Kellison, R.C. and M.J. Young. 1997. The bottomland hardwood forest of the southern United States. Forest Ecology and Management 90 (2-3): 101-115.

Kennedy, H.E. and G.J. Nowacki. 1997. An old-growth definition for seasonally wet oak hardwood woodlands. USDA Forest Service GTR SRS-8.

Lederer, John, 1672 [1966] The Discoveries of John Lederer, translated by Sir William Talbot, Readex Microprint, 1966

Lentz, G.H. 1931. Forest fires in the Mississippi bottomlands. Journal of Forestry 29: 831-832.

Lockaby, B.G., J.A. Stanturf and M.G. Messina. 1997. Effects of silvicultural activity on ecological processes in floodplain forests of the southern United States: a review of existing reports. Forest Ecology and Management 90 (2-3): 93-100.

Logan, John H. 1859. A history of the upper country of South Carolina. Vol. I (Vol. II never pub.) S.G. Courtenay & Co., Charleston, S.C. 521 pp.

McWilliams, W.H. and J. F. Rosson, Jr. 1990. composition and vulnerability of bottomland hardwood forests of the Coastal Plain Province in the south central United States. Forest Ecology and Management 33: 485-501.

Monk, C. D., D. W. Imm, R. L. Potter and G. G. Parker. 1989. A classification of the deciduous forest of eastern North America. Vegetation 80: 167-181. NatureServe. 2004. International Ecological Classification Standard: Terrestrial Ecological Classifications – Piedmont (Ecoregion 52). NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of May 2004.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 15 April 2007.

Palik, B.J., J.C. Zasada and C.W. Hedman. Chapter 14. Ecological principles for riparian Silviculture. In: Riparian management in forests of the continental Eastern United States. E.S. Verry, J.W. Hornbeck and C.A. Dolloff (editors). Lewis Publishers.

Runkle, J.R. 1981. Gap regeneration in some old-growth forests of the eastern United States. Ecology 62: 1041-1051.

Schmidt, Kirsten M, Menakis, James P., Hardy, Colin C., Hann, Wendel J., Bunnell, David L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 pp. + CD.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve

Sharitz, R.R. and W.J. Mitsch. 1993. Southern floodplain forests. Pgs. 311-371 in W.H. Martin, S.G. Boyce and A.C. Echternacht (eds). Biodiversity of the Southeastern United States. John Wiley and Sons, New York.

Smith, L. 1988. The natural communities of Louisiana. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA.

Tanner, J.T. Distribution of tree species in Louisiana bottomland forests. Castanea 51: 168-174.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/.

Wharton, C.H. 1989. The natural environments of Georgia. Georgia Department of Natural Resources, Environmental Protection Division, Atlanta, GA.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**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 seve