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

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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,

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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

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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)
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- 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.

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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

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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).

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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:
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Disturbances

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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.

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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.

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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.

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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.

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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

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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

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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
- ☐ Native Grazing
- ☑ Other (optional 1) extreme weather
- ☑ 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.

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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.

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