Rapid Assessment Reference Condition Model

The Rapid Assessment is a component of the LANDFIRE project. Reference condition models for the Rapid Assessment were created through a series of expert workshops and a peer-review process in 2004-2005. For more information, please visit www.landfire.gov. Please direct questions to helpdesk@landfire.gov.

Potential Natural Vegetation Group (PNVG):

R8FPFOpi **Bottomland Hardwood Forest**

General Information

Contributors *(additional contributors may be listed under "Model Evolution and Comments")*

Modelers

Justin Shedd jmshedd@ncsu.edu

Bill Millinor bmillinor@ncsu.edu

Reviewers

Wayne Clatterbuck wclatter@utk.edu

Carl Nordman Carl_Nordman@natureserve.org

Vegetation Type

Forested

Dominant Species*

PLATA	CELA
BENI	FAGR
ACRU	FRPE
LIQUI	

General Model Sources

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

LANDFIRE Mapping Zones

47	54
48	57
53	59

Rapid Assessment Model Zones

- [ ] California
- [ ] Great Basin
- [ ] Great Lakes
- [ ] Northeast
- [ ] Northern Plains
- [ ] N-Cent.Rockies
- [ ] Pacific Northwest
- [ ] South Central
- [ ] Southeast
- [x] S. Appalachians
- [ ] Southwest

Geographic Range

Occurs near rivers on floodplains and terraces affected by river and stream flooding, including floodplains of the larger rivers and streams that flow mainly west encompassing a majority of the Tennessee Valley and Ridge geologic region. Additional areas included are the foothills of the Southern Appalachians extending from western North Carolina wrapping around the Appalachian toe to include Northern Georgia and Alabama. This model also includes floodplains of the major rivers extending from the Piedmont into the mountain valleys of the southern and central Ridge and Valley Province, the Blue Ridge, the Cumberlands, the Interior Low Plateau, and Interior Highlands. Rivers include those such as the Ohio, Chattooga, Tennessee, French Broad, Cumberland, Green, Duck, and Clinch. This model encompasses the broad vegetated floodplains of these and similar large, low gradient rivers, immediate tributaries, and smaller streams. It does not include the floodplain forests of the Atlantic southeast and Gulf Coastal Plain nor the high gradient, narrow headwater streams of the Appalachian and Ouachita/Ozark mountains.

Biophysical Site Description

This bottomland type 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 old oxbow lakes. 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. Synonyms for this BpS (PNVG) and its variations include eastern riverfront forest, bottomland hardwood forest, and alluvial forest. In pre-European settlement forests, community diversity in these wetland systems was much more complex. Fire and beaver activity created a mosaic whose elements included 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. Neglecting beaver communities, which will be covered in another model, at least three major groupings of bottomland forest can be defined: bottomland hardwoods, levee forests, and canebrakes. Nearly all the canopy species are deciduous. The most prominent evergreen is the shade-intolerant loblolly pine (Pinus taeda), which manages to maintain itself by reproducing in larger (multi-tree) treefall gaps.

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). The driest and most fire sheltered sites supported the wetland hickories including Carya glabra, and Carya ovata and other fire sensitive species such as beech (Fagus grandifolia). Successional areas are often dominated by sweetgum (Liquidambar styraciflua), or tulip tree (Liriodendron tulipifera). 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), grasses (Elymus hystrix, Elymus canadensis, and Chasmanthium latifolium), and false nettle (Boehmeria cylindrica) may be present. 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. There are numerous accounts of canebrake 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 reenforce 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. IECS ecological systems that this RA model crosswalks to are: CES202.608, CES202.694, CES202.705, CES202.324, CES202.609, CES202.706, CES202.323, CES203.512, CES203.559.

Disturbance Description

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 litter with some thin, patchy cover of bottomland grasses such as 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 3-8 years in canebrake and bottomland hardwood/canebrake, to 25 years or more in hardwood litter. Low areas having a long hydroperiod, islands, and areas protected from fire by backswamps 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 windthrow 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 20 year 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 windthrow. Note that tornados are common outside hurricane events in the western extent of this model zone.

Adjacency or Identification Concerns

Compare to Southern Flood Plain model for the Atlantic and Gulf coastal plain variant of this type. This coastal type is characterized by wider floodplains and vegetation adapted to greater inundation including baldcypress (Taxodium distichum) and gums such as tupelo (Nyssa aquatica), swamp black gum (Nyssa biflora) and Ogeechee plum (Nyssa ogeche) in the southern part of the range. Long hydroperiods are characteristic and permanent standing water may be found where these stands occur at sea level. Piedmont and mountain river floodplain forests are differentiated from adjacent mesophytic upland forests (see 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). Particularly in the western extent of this model zone, these bottomlands have been extensively altered by dams, which allow drier-associated species such as oaks to encroach, and surface fires to creep in during droughty periods.

Scale Description

Sources of Scale Data ☑ Literature ☐ Local Data ☑ Expert Estimate

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. (>5,000 acres).

Issues/Problems

Model Evolution and Comments

Quality control resulted in changed disturbance path for Mixed Fire in Class A to C because this would advance age (rule violation). The results of the model did not visibly change. Major review comments related to the possible East of the Mountains bias of this model. The reviewer indicated that these sites to the west are drier now due to dams, which alters the species mix and FRI. However, since dams are post-European disturbances, their affect should not be included in the model. Also, during the LANDFIRE modeling process, more attention should be placed on the potential species differences between the areas East and West of the mountains. One reviewer indicated that the Optional disturbances were not thoroughly defined, but no changes were made because other reviewer and modeling lead felt that they were described adequately.

Succession Classes

Succession classes are the equivalent of "Vegetation Fuel Classes" as defined in the Interagency FRCC Guidebook (www.frcc.gov).

Class A 10%

Early1 All Structures

Description

Treefall gaps 0-20 years in age with saplings and small trees up to 30 cm 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).

Indicator Species* and Canopy Position

ACRU	All
LIQUI	All
FRPE	All

Upper Layer Lifeform

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

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	60 %
Height	Tree Regen <5m	Tree Medium 10-24m
Tree Size Class	Pole 5-9" DBH	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class B 25%

Mid1 Closed

Description

Old treefall gaps with closed canopy 20-80 years in age, ranging from 30-70 cm dbh. Shade tolerant species in the understory.

Indicator Species* and Canopy Position

ACRU	Upper
LIQUI	Upper
BENI	Upper
CELA	Upper

Upper Layer Lifeform

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

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	Max
Cover	75 %	90 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Medium 9-21"DBH	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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

Class C 5 %

Mid1 Open

Description

Similar overstory as B but more open 0 - 69 years in age but without well-developed midstory or understory. Grasses will also be present.

Indicator Species* and Canopy Position

PLATA Upper
CELA Upper
FAGR Upper
BENI Upper

Upper Layer Lifeform

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

Fuel Model 8

Structure Data (for upper layer lifeform)

	Min	Max
Cover	60 %	75 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Medium 9-21"DBH	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class D 10 %

Late1 Open

Description

More of a closed canopy then C with trees ranging from 50 to > 300 years in age with minimal midstory and understory shrubs and grasses. More shrubs and less grass than C.

Indicator Species* and Canopy Position

PLATA Upper
CELA Upper
FAGR Upper
BENI Upper

Upper Layer Lifeform

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

Fuel Model 8

Structure Data (for upper layer lifeform)

	Min	Max
Cover	70 %	90 %
Height	Tree Medium 10-24m	Tree Giant >50m
Tree Size Class	Large 21-33"DBH	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class E 50 %

Late1 Closed

Description

Closed hardwood canopy with trees ranging from 80 to >300 years in age. Extensive shade tolerant shrub understory and midstory.

Indicator Species* and Canopy Position

PLATA Upper
CELA Upper
FAGR Upper
BENI Upper

Upper Layer Lifeform

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

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	Max
Cover	75 %	100 %
Height	Tree Tall 25-49m	Tree Giant >50m
Tree Size Class	Large 21-33"DBH	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Disturbances

Non-Fire Disturbances Modeled

- [ ] Insects/Disease
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [x] Competition
- [x] Other: flooding
- [x] Other: hurricane/tornado

Fire Regime Group: 3

I: 0-35 year frequency, low and mixed severity
II: 0-35 year frequency, replacement severity
III: 35-200 year frequency, low and mixed severity
IV: 35-200 year frequency, replacement severity
V: 200+ year frequency, replacement severity

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

Historical Fire Size (acres)

Avg: 1500

Min: 10

Max: 3000

Sources of Fire Regime Data

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals (FI):

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse 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. All values are estimates and not precise.

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	435	200	1000	0.0023	25
Mixed	455	150	500	0.0022	24
Surface	210	50	250	0.00476	51
All Fires	108			0.00926	

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: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 p.

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.

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.

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.

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 p.

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. 2005. International Ecological Classification Standard: Terrestrial Ecological Classifications. Natureserve Central Databases. Arlington, VA. U.S.A. Data Current as of March 15, 2005.

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: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 41 p. + 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, Louisiana.

Tanner, J.T. Distribution of tree species in Louisiana bottomland forests. Castanea 51:168-174.
U.S. Department of Agriculture, 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.