

13680

Southern Piedmont Dry Oak(-Pine) Forest

BpS Model/Description Version: Aug. 2020

Modelers		Reviewers	
Robin Mackie	rmackie@fs.fed.us	Milo Pyne	milospyne@naturereserve.org
John Mason	john_mason@fws.gov	Robin Mackie	rmackie@fs.fed.us
Gary Curcio	gary.curcio@ncmail.net	John Mason	John_Mason@fws.gov

Vegetation Type

Forest and Woodland

Map Zones

46, 48, 54, 57, 59, 60, 61

Geographic Range

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

The northern range limit in Virginia, 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 300-1,200ft elevation. Several erosion-resistant metamorphic and igneous rock types have left monadnocks that stand 200-1,000ft above the remaining landscape. Average annual precipitation 44-48in. 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 5mi 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.

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 typical 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 oak (*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 arboreum*), blackgum (*Nyssa sylvatica*), and sweetgum (*Liquidambar styraciflua*). The shrub layer included blueberries (*Vaccinium* spp.), huckleberries (*Gaylussacia* spp.), beautyberry (*Callicarpa americana*), St. John's wort (*Hypericum* spp.), and the vines Carolina Jessamine (*Gelsemium sempervirens*) and wild grape (*Vitis rotundifolia*) (NatureServe, 2007). Understory of more forested areas was variable.

NatureServe (2007) notes that in successional forest examples of this system that are 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, particularly *Acer rubrum*. This may be a result of loss of regular fire in the system.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
QUAL	<i>Quercus alba</i>	White oak
QUFA	<i>Quercus falcata</i>	Southern red oak
PIEC2	<i>Pinus echinata</i>	Shortleaf pine
CAGL8	<i>Carya glabra</i>	Pignut hickory
CAAL27	<i>Carya alba</i>	Mockernut hickory
VACCI	<i>Vaccinium</i>	Blueberry
SCSC	<i>Schizachyrium scoparium</i>	Little bluestem
SONU2	<i>Sorghastrum nutans</i>	Indiangrass

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

Disturbance Description

This system is impacted by disturbances at different scales and in different seral states (estimated historic frequencies for the various modeled disturbances are included in this description below). In the later, more persistent portions of the life cycle, small canopy gaps may be created across the landscape by the death of individual (or small numbers of) trees which topple. However, weather related events (ice, wind, etc.) could have created gaps in the mature canopy that range from individual tree size to larger areas depending on the specific incident. Fire also occurred, mostly at low and moderate intensities, and could create much larger openings or more open forest canopies when they occur in any seral stage.

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 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 (FRI), community succession tends to favor upland mixed pine-xeric hardwood forests or hardwood-dominated forests. Landers (1989) inferred an FRI 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.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	325	2	100	300
Moderate (Mixed)	235	2		
Low (Surface)	5	96	1	10
All Fires	5	100		

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

Naturally a matrix system with contiguous patches covering many 1,000s of acres and dominating most of the upland landscape in the Piedmont. Remnants are mostly large patch, but some large expanses remain (100s of acres). A few areas have substantially forested landscapes in which oak-hickory forests in some condition cover 1,000s of acres in nearly contiguous patches (NatureServe 2007).

Surface fires may range in size from 10-5,000ac. 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 openings were created by replacement fires following extensive droughts coupled with severe bark beetle mortality.

Adjacency or Identification Concerns

Grades into Appalachian shortleaf pine/oak hickory pine above ~1,200ft 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, personal communication). On the piedmont, there were smaller and more dispersed prairies that 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 that retard woody succession.

Issues or 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).

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 due to 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, and tulip poplar are more common due to lack or exclusion of frequent fire.

Comments

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.

Succession Classes

Mapping Rules

Upper Layer Lifeform	Height (m)	Canopy Cover (%)									
		0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Herb	0-0.5	A	A	A	A	A	A	A	A	A	A
Herb	0.5-1.0	A	A	A	A	A	A	A	A	A	A
Herb	>1.0	A	A	A	A	A	A	A	A	A	A
Shrub	0-0.5	A	A	A	A	A	A	A	A	A	A
Shrub	0.5-1.0	A	A	A	A	A	A	A	A	A	A
Shrub	1.0-3.0	A	A	A	A	A	A	A	A	A	A
Shrub	>3.0	A	A	A	A	A	A	A	A	A	A
Tree	0-5	A	A	A	A	A	A	A	A	A	A
Tree	5-10	C	C	C	C	C	C	C	B	B	B
Tree	10-25	C	C	C	C	C	C	C	B	B	B
Tree	25-50	D	D	D	D	D	D	D	E	E	E
Tree	>50	D	D	D	D	D	D	D	E	E	E

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

Description

Class A	7	Early Development 1 - All Structures
Upper Layer Lifeform: Tree		

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIEC2	<i>Pinus echinata</i>	Shortleaf pine	Upper
QUAL	<i>Quercus alba</i>	White oak	Upper
VAAR	<i>Vaccinium arboreum</i>	Farkleberry	Low-Mid
SCSC	<i>Schizachyrium scoparium</i>	Little bluestem	Lower

Description

Pine and oak reproduction to 15ft tall. Community of forbs and perennial grasses. More common on dry sites dominated by pines susceptible to fire and pine beetles. Forms as small openings with scattered live trees surviving recent disturbance.

Class B **16**

Mid Development 1 - Closed

Upper Layer Lifeform: Tree

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIEC2	<i>Pinus echinata</i>	Shortleaf pine	Upper
QUAL	<i>Quercus alba</i>	White oak	Upper
LITU	<i>Liriodendron tulipifera</i>	Tuliptree	Upper
COFL2	<i>Cornus florida</i>	Flowering dogwood	Low-Mid

Description

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.

Class C 24

Mid Development 1 - Open

Upper Layer Lifeform: Tree

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIEC2	<i>Pinus echinata</i>	Shortleaf pine	Upper
QUST	<i>Quercus stellata</i>	Post oak	Upper
VAAR	<i>Vaccinium arboreum</i>	Farkleberry	Low-Mid
SCSC	<i>Schizachyrium scoparium</i>	Little bluestem	Lower

Description

Prairie, savanna, and/or open woodland with pines, oaks, shrubs, and a grass/forb-dominated understory.

Class D 41**Late Development 1 - Open**

Upper Layer Lifeform: Tree

Upper-layer lifeform is not the dominant lifeform. Herbaceous understory predominant on upper south-facing slopes.

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIEC2	<i>Pinus echinata</i>	Shortleaf pine	Upper
QUST	<i>Quercus stellata</i>	Post oak	Upper
VAAR	<i>Vaccinium arboreum</i>	Farkleberry	Lower
SCSC	<i>Schizachyrium scoparium</i>	Little bluestem	Lower

Description

Prairie, savanna, and open woodland with large pines and oaks, with shrubs and a grass/forb-dominated understory.

Class E 12**Late Development 1 - Closed**

Upper Layer Lifeform: Tree

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
CAAL27	<i>Carya alba</i>	Mockernut hickory	Upper
QURU	<i>Quercus rubra</i>	Northern red oak	Upper
LITU	<i>Liriodendron tulipifera</i>	Tuliptree	Upper
QUAL	<i>Quercus alba</i>	White oak	Upper

Description

This class represents a closed-canopy, late-seral stage with older trees. The closed canopy is dominated by oaks and hickory, with understory components including American beech, red maple, dogwood, sourwood, sassafras, and blackgum. 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.

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:OPN	15
Mid1:OPN	16	Late1:OPN	75
Mid1:CLS	16	Late1:CLS	75

Late1:OPN	76	Late1:OPN	999
Late1:CLS	76	Late1:CLS	999

Probabilistic Transitions

Disturbance Type	Disturbance occurs In	Moves vegetation to	Disturbance Probability	Return Interval (yrs)	Reset Age to New Class Start Age After Disturbance?	Years Since Last Disturbance
Alternative Succession	Early1:ALL	Mid1:CLS	1	1	Yes	14
Replacement Fire	Early1:ALL	Early1:ALL	0.005	200	Yes	0
Surface Fire	Early1:ALL	Early1:ALL	0.08	13	No	0
Alternative Succession	Mid1:OPN	Mid1:CLS	1	1	Yes	12
Wind or Weather or Stress	Mid1:OPN	Early1:ALL	0.003	333	Yes	0
Native Grazing	Mid1:OPN	Mid1:OPN	0.004	250	No	0
Replacement Fire	Mid1:OPN	Early1:ALL	0.005	200	Yes	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.25	4	No	0
Wind or Weather or Stress	Mid1:CLS	Early1:ALL	0.003	333	Yes	0
Replacement Fire	Mid1:CLS	Early1:ALL	0.003	333	Yes	0
Insects or Disease	Mid1:CLS	Mid1:OPN	0.004	250	Yes	0
Wind or Weather or Stress	Mid1:CLS	Mid1:OPN	0.005	200	Yes	0
Mixed Fire	Mid1:CLS	Mid1:OPN	0.02	50	Yes	0
Surface Fire	Mid1:CLS	Mid1:CLS	0.05	20	No	0
Alternative Succession	Late1:OPN	Late1:CLS	1	1	Yes	15
Wind or Weather or Stress	Late1:OPN	Early1:ALL	0.002	500	Yes	0
Replacement Fire	Late1:OPN	Early1:ALL	0.002	500	Yes	0
Insects or Disease	Late1:OPN	Early1:ALL	0.002	500	Yes	0
Native Grazing	Late1:OPN	Late1:OPN	0.007	143	No	0
Surface Fire	Late1:OPN	Late1:OPN	0.25	4	No	0
Insects or Disease	Late1:CLS	Late1:OPN	0.002	500	Yes	0
Wind or Weather or Stress	Late1:CLS	Early1:ALL	0.002	500	Yes	0
Replacement Fire	Late1:CLS	Early1:ALL	0.002	500	Yes	0

Wind or Weather or Stress	Late1:CLS	Late1:OPN	0.01	100	Yes	0
Mixed Fire	Late1:CLS	Late1:OPN	0.01	100	Yes	0
Surface Fire	Late1:CLS	Late1:CLS	0.06	17	No	0

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.

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.