

13030

Northeastern Interior Dry-Mesic Oak Forest

BpS Model/Description Version: Aug. 2020

Update: 3/18

Modelers		Reviewers	
Daniel Yaussy	dyaussy@fs.fed.us	Thomas Schuler	tschuler@fs.fed.us
Greg Nowacki	gnowacki@fs.fed.us		

Vegetation Type

Forest and Woodland

Map Zones

60

Geographic Range

This model as it was developed, pertains to Ecological Section 221E (Cleland et al. 2007; USDA Forest Service Eastern Region 1995), the Southern Unglaciaded Allegheny Plateau (EPA level III region 70--Western Allegheny Plateau) and possibly 221H, the Northern Cumberland Plateau (northern portion of EPA level III region 68 -- Southwestern Appalachians).

NatureServe's description (2007) for the equivalent ecological system CES202.592 -- Northeastern Interior Dry-Mesic Oak Forest notes this system is found from central New England west through Ohio and Pennsylvania and south to Virginia. It does not extend to the southernmost part of Virginia, except in the Ridge and Valley.

Biophysical Site Description

This ecological section comprises part of the Appalachian Plateaus geomorphic province (USDA Forest Service 1995). It is a maturely dissected plateau characterized by high hills, sharp ridges, and narrow valleys. Bedrock is overlain by Quaternary residuum on the ridges and hilltops, colluvium on the slopes, and either or both alluvium and Pleistocene lacustrine materials in the valleys. Udalfs, Udults, and Ochrepts dominate, in combination with mesic soil temperature regime, an udic soil moisture regime, and mixed or illitic mineralogy. Soils formed in parent materials are divided into five groups: residual material, which developed in place by the weathering of underlying bedrock; colluvial material which weathered from bedrock strata transported by water and gravity to the lower slopes; alluvium, lacustrine sediments and outwash deposited by water; and loess deposited by wind. Precipitation averages 35-45in (900-1,150mm); it occurs mainly during summer, winter, and spring. Rain on snow is common during winter and early spring. Summers are dry with low humidity. Temperature averages 52 degrees F (11 degrees C). The growing season is 120-180 days. This ecological section is characterized by a relatively high density of streams, with gradients ranging from high, steep headwaters streams to low gradient rivers that flow into the Ohio River.

NatureServe (2007) provides the following description pertaining to this system type. These oak-dominated forests are one of the matrix forest systems in the northeastern and north-central

United States. Occurring in dry-mesic settings, they are typically closed-canopy forests, though there may be areas of patchy-canopy woodlands. They cover large expanses at low to mid elevations, where the topography is flat to gently rolling, occasionally steep. Soils are acidic and relatively infertile but not strongly xeric. Southern Appalachian Oak Forest (CES202.886 – Biophysical Setting 1315)--is an equivalent system to the south (in the Southern Blue Ridge, EPA 66).

Vegetation Description

The vegetation consisted of forests dominated by oaks of dry-mesic conditions, especially white oak (*Quercus alba*) and 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*), and other species such as white pine (*Pinus strobus*) and white ash (*Fraxinus americana*). American chestnut (*Castanea dentata*) was a prominent tree in these forests before chestnut blight eradicated it as a canopy constituent (NatureServe 2007). Common shrubs include mountain laurel (*Kalmia* spp.), greenbriar (*Smilax* spp.), blueberries (*Vaccinium* spp.), and huckleberries (*Gaylussacia* spp.). In the Ridge and Valley region, bear oak is an important shrub component. Herbs, forbs, and ferns are usually sparse to moderate in density. Areas experiencing frequent fire had a greater abundance of grasses and sedges.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
QUAL	<i>Quercus alba</i>	White oak
QUVE	<i>Quercus velutina</i>	Black oak
QUPR2	<i>Quercus prinus</i>	Chestnut oak
QURU	<i>Quercus rubra</i>	Northern red oak
QUCO2	<i>Quercus coccinea</i>	Scarlet oak
ACRU	<i>Acer rubrum</i>	Red maple
PIST	<i>Pinus strobus</i>	Eastern white pine
CARYA	<i>Carya</i>	Hickory

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.

Most oaks are long-lived with typical age of mortality ranging from 200-400yrs. Scarlet and black oaks are shorter-lived with typical ages being approximately 50-100yrs, while white oaks can live as long as 600yrs. Extreme wind or ice storms occasionally create larger canopy openings.

The dry-mesic oak forest is predominantly Fire Regime I, characterized by low-severity surface fires. Historically, indigenous fires accounted for more than 95% of the ignitions over these landscapes. Vegetation types varied based on fire frequency and intensity. Grassland prairies 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 tree-sprout and shrub thickets occurred where fire frequency was a bit less, probably 3-9yrs. Also, sprout conditions would 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 averaging every 5-15yrs. 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 7-32yrs from 1846 to 2002, with a median of approximately 16yrs, and prior to the fire control era ranged from 7-15yrs (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 Rapid Assessment (RA) model R6OAH1 -- Oak Hickory.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	7	53		
Moderate (Mixed)	17	22		
Low (Surface)	15	25		
All Fires	4	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

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

These were historically among the most important matrix forests of the Northeast. They covered extensive areas where conditions were not extreme. Upslope they may grade into more xeric oak ridge systems or rocky oak-pine forests/woodlands (NatureServe 2007).

Adjacency or Identification Concerns

Dry mesic oak forests often occur on hill tops and side slopes. Though often contiguous, patches of oak are virtually always convoluted and inter-fingered with other systems, especially Mesophytic Cove Forests and Dry-Xeric Oak-Pine Forests. At the highest elevations it may grade into Northern Hardwood Forests. Small patches of other communities, such as rock outcrops and mountain wetlands, are sometimes embedded within this group.

Issues or Problems

This type occurs across many coarse mapped RA Potential Natural Vegetation Groups. Many oak-dominated models are redundant, overlap, or are similar.

With a long history of human habitation, many of these forests today are early- to mid-successional, where *Pinus strobus*, *Pinus virginiana*, or *Liriodendron tulipifera* may be dominant or codominant (NatureServe 2007).

American Chestnut was once a dominant species in this type, but was reduced dramatically in the 1930s. Mountain Laurel and rhododendron have increased in the understory in many places in absence of fire, which could pose regeneration problems in the future. Invasive exotics such as Tree-of-Heaven (*Ailanthus altissima*), privet (*Ligustrum* sp.), and many others are on the increase and pose forest health issues. Exclusion of fire is slowly transitioning oak forests on better sites to shade tolerant species such as beech and maple.

In addition, a build-up of ericaceous shrubs and other species might lead to fire intensity beyond the range of historical variability when fires were more frequent. Consequently, overstory mortality in conjunction with fire may be significant and harm remnants of rare communities that add significant diversity to the landscape (Schuler personal communication).

Native Uncharacteristic Conditions

American Chestnut was once a dominant species in this type, but was reduced dramatically in the 1930s.

Comments

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	B	B	B	B	B	B	UN	UN	UN	UN
Shrub	0.5-1.0	B	B	B	B	B	B	UN	UN	UN	UN
Shrub	1.0-3.0	B	B	B	B	B	B	UN	UN	UN	UN
Shrub	>3.0	B	B	B	B	B	B	UN	UN	UN	UN
Tree	0-5	B	B	B	B	B	B	UN	UN	UN	UN
Tree	5-10	UN	UN	C	C	C	C	D	D	E	E
Tree	10-25	UN	UN	C	C	C	C	D	D	E	E
Tree	25-50	UN	UN	C	C	C	C	D	D	E	E
Tree	>50	UN	UN	C	C	C	C	D	D	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	22	Early Development 1 - All Structures
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ANGE	Andropogon gerardii	Big bluestem	None
SCHIZ4	Schizachyrium	Little bluestem	None
SONU2	Sorghastrum nutans	Indiangrass	None

Description

Class A is grassland prairie maintained by frequently recurring fire (1-2yrs). These patches would typically be less than 100ac, but may have been up to 500ac. Native Americans used these lands for hunting, and agriculture/native plant gathering. If fire is absent, tree seedlings and sprouts will establish and move the community to the mid-seral, open stage.

Maximum Tree Size Class

None

Class B	34	Mid Development 1 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAL	Quercus alba	White oak	Upper
QURU	Quercus rubra	Northern red oak	Upper
ANGE	Andropogon gerardii	Big bluestem	Low-Mid
QUVE	Quercus velutina	Black oak	Upper

Description

This is an early tree regeneration (seedling; root and stump sprouts) phase; fire frequency is about 3-9yrs. 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 oak-hickory forest class. Occasional fires of high severity will top-kill all trees moving the community back to the early-seral class.

Maximum Tree Size Class

Sapling >4.5ft; <5"DBH

Class C	30	Mid Development 2 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
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QUAL	Quercus alba	White oak	Upper
QURU	Quercus rubra	Northern red oak	Upper
QUVE	Quercus velutina	Black oak	Upper
QUCO2	Quercus coccinea	Scarlet oak	Upper

Description

This class is defined as open oak savannas and woodlands with a fire return interval of 5-15yrs. 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, oak forest.

Maximum Tree Size Class

Large 21-33"DBH

Class D	10	Late Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAL	Quercus alba	White oak	Upper
QURU	Quercus rubra	Northern red oak	Upper
QUCO2	Quercus coccinea	Scarlet oak	Upper
QUVE	Quercus velutina	Black oak	Upper

Description

Class D is defined as closed oak forest. Understories of oak seedlings exist. Stand replacement fires in late-succession types are rare and will result in return to a grassland stage. If the late-succession open forest type persists without any fire, it will eventually convert to a late-succession mixed mesophytic closed forest type. This conversion is a result of species shift from dominant oaks to dominant maple, tuliptree, and beech, which do not support fire as readily.

Maximum Tree Size Class

Large 21-33"DBH

Class E	4	Late Development 2 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ACRU	Acer rubrum	Red maple	Upper
ACSA3	Acer saccharum	Sugar maple	Upper
LIRIO	Liriodendron	Tuliptree	Upper
FAGR	Fagus grandifolia	American beech	Upper

Description

Mixed mesophytic forests develop during the absence of fire. Dense understories of shade-tolerant species develop. Replacement fires are very rare and will move the stand to a grassland system. Gap-phase dynamics will maintain this system. Large-scale wind and drought events might convert this system to the late-succession open class. Wind events may remove the oak overstory, releasing the shade-tolerant mid-story and converting the stand to the closed canopy mixed-mesophytic class.

Maximum Tree Size Class

Large 21-33"DBH

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:OPN	2
Mid1:OPN	3	Mid2:OPN	19
Mid2:OPN	20	Mid2:OPN	299
Late2:CLS	20	Late2:CLS	869
Late1:CLS	50	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
Replacement Fire	Early1:ALL	Early1:ALL	0.5	2	Yes	0
Replacement Fire	Mid1:OPN	Early1:ALL	0.1	10	Yes	0
Mixed Fire	Mid1:OPN	Mid1:OPN	0.15	7	No	0
Alternative Succession	Mid2:OPN	Late1:CLS	1	1	Yes	15
Replacement Fire	Mid2:OPN	Early1:ALL	0.002	500	Yes	0
Wind or Weather or Stress	Mid2:OPN	Mid1:OPN	0.003	333	Yes	0
Mixed Fire	Mid2:OPN	Mid1:OPN	0.015	67	Yes	0
Surface Fire	Mid2:OPN	Mid2:OPN	0.2	5	No	0
Alternative Succession	Late1:CLS	Late2:CLS	1	1	Yes	70
Replacement Fire	Late1:CLS	Early1:ALL	0.002	500	Yes	0
Wind or Weather or Stress	Late1:CLS	Late2:CLS	0.003	333	Yes	0
Mixed Fire	Late1:CLS	Mid1:OPN	0.005	200	Yes	0
Wind or Weather or Stress	Late1:CLS	Mid2:OPN	0.007	143	Yes	0
Mixed Fire	Late1:CLS	Mid2:OPN	0.015	67	Yes	0
Surface Fire	Late1:CLS	Late1:CLS	0.075	13	No	0

Replacement Fire	Late2:CLS	Mid1:OPN	0.001	1000	Yes	0
Wind or Weather or Stress	Late2:CLS	Mid1:OPN	0.007	143	Yes	0
Surface Fire	Late2:CLS	Late2:CLS	0.02	50	No	0

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