13030
Northeastern Interior Dry-Mesic Oak Forest

BpS Model/Description Version: Aug. 2020

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Vegetation Type
Forest and Woodland

Map Zones
62

Geographic Range
This model as it was developed, pertains to Ecological Section 221E, the Southern Unglaciated 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 OH and PA and south to VA. It does not extend to the southernmost part of VA, except in the Ridge and Valley.

In MZ62, this BpS is found on the unglaciated and glaciated Allegheny plateau, being replaced by 1310 (North-Central Interior Dry-Mesic Oak Forest and Woodland) west of this area in Subsections 222Ha and 222Hb. Sections supporting 1303 include 222Ia, 221Fb, 221Fc, 221Fa, 221Ee, 221Ed, 221Ef, 221Eg, 221Ec, 221Ea, 221Eb, M221Ca, and 211Ga.

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 to 45in (900 to 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 to 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 US. 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.

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 (including Carya cordiformis, C. ovata and C. tomentosa) and a mix of other species, including sugar maple (Acer saccharum), red maple (Acer rubrum), white ash (Fraxinus americana), beech (Fagus grandifolia), yellow birch (Betula alleghaniensis), and sweet birch (B. lenta) (Braun 1950, Fike 1999, NatureServe 2007). American chestnut (Castanea dentata) made up perhaps 5-15% of the canopy in OH examples of these forests before chestnut blight eradicated it as a canopy constituent (NatureServe 2007). Big-tooth aspen (Populus grandidentata) is a common disturbance (fire, wind, and ice) indicator. Common shrubs include northern arrow-wood (Viburnum recognitum), southern arrow-wood (V. dentatum), maple-leaved viburnum (V. acerifolium), hop-hornbeam (Ostrya virginiana), flowering dogwood (Cornus florida), mountain laurel (Kalmia latifolia), greenbriars (Smilax rotundifolia, S. tamnoides), blueberries (Vaccinium spp.), and huckleberry (Gaylussacia baccata) (Fike 1999, NatureServe 2007). Herbs, forbs, and ferns are usually sparse to moderate in density. Characteristic species include bluestem goldenrod (Solidago caesia), sedges (including Carex blanda, C. digitalis, C. latifolia, C. pensylvanica, and C. rosea), false Solomon's seal (Smilacina racemosa), nakedflower tick-trefoil (Desmodium nudiflorum), wild-oats (Uvularia sessilifolia), whorled loosestrife (Lysimachia quadrifolia), pipsissewa (Chimaphila maculata), and several others (Fike 1999, Goebel et al. 2005, NatureServe 2007). Areas experiencing frequent fire had a greater abundance of grasses and sedges.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
QUAL	*Quercus alba*	White oak
QUVE	*Quercus velutina*	Black oak
QURU	*Quercus rubra*	Northern red oak
QUPR2	*Quercus prinus*	Chestnut oak
QUCO2	*Quercus coccinea*	Scarlet oak
CAGL8	*Carya glabra*	Pignut hickory
CAOV2	*Carya ovata*	Shagbark hickory
ACRU	*Acer rubrum*	Red maple

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

The dry-mesic oak forest is predominantly Fire Regime I, characterized by low-severity surface fires. Historically, indigenous fires accounted for over 95% of the ignitions over these landscapes. Vegetation types varied based on fire frequency and intensity. 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, nut-gathering, berry-harvesting, etc. purposes, were probably scattered throughout the forest matrix, but were concentrated on flat ridgetops and larger stream floodplains. Oak-hickory tree-sprout and shrub thickets occurred where fire frequency was a bit less, probablythree to nine years.. 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 five to 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 seven to 32yrs from 1846 to 2002 with a median of approximately 16yrs, and prior to the fire control era ranged from seven to 15yrs (Schuler and McClain, 2003). Schuler and McClain stated that these observations did not deviate significantly from previous research in the oak forests of OH, MD and MO. -- The above description was taken from RA model R6OAHI -- Oak Hickory.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	39	15		
Moderate (Mixed)	52	11	5	50
Low (Surface)	8	74	2	25
All Fires	6	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 this system may grade into Northern Hardwood Forests. Small patches of other communities, such as rock outcrops and mountain wetlands, are sometimes embedded within this group.
Southern Appalachian Oak Forest (CES202.886 -- BpS 1315)--is an equivalent system to the south (in the Southern Blue Ridge, EPA 66).

Issues or Problems
This type occurs across many coarse mapped RA PNVGs. Many oak-dominated models are redundant, overlap, or are similar.

American Chestnut was once an occasional canopy species in this type, but was reduced dramatically in the 1930s. Invasive exotics such as Tree-of-Heaven (Ailanthus altissima), privet (Ligustrum sp.), Japanese stilt grass (Microstegium vimineum), and many others are on the increase and also 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 many oak-dominated stands, maples and beech dominate sub-canopy strata (McEwan et al. 2007).

In addition, a build-up of ericacous shrubs and other species might lead to fire intensity beyond the range of historical variability when fires were more frequent. This phenomenon is likely more characteristic of mesophytic systems in the southern Appalachians. Consequently, overstory mortality in conjunction with fire may be significant and harm remnants of rare communities that add significant diversity to the landscape (Schuler pers. Comm.).

There will be significant changes with the entry of beech bark disease and hemlock wooly adelged in stands containing these species. Gypsy moth still has the potential to cause major ecosystem shifts, especially in the dry oak-dominated forests. Heavy mortality from gypsy moth seems to promote red maple and black birch (the birch is mostly in the northern part of WV and central PA. Red maple often follows and succeeds oaks in the absence of fire. Whitetailed deer impacts are especially important in some areas, especially in PA and the Ridge and Valley of West VA. Their impact will be to retard oak regeneration, and since we have little experience with deer herds as high as they are in these areas, only time will tell as to their long-term impact.

Timber high-grading (cutting the best and leaving the rest) is also a pretty big factor, especially on NIPF land. I think it will promote an increase in red maple, blackgum and hickories, at the expense of oaks. Diameter-limit cutting often produces a similar result, with a shift from oaks and yellow-poplar to maples, beech, blackgum, hickories, etc.

The abundance of yellow-poplar in the Appalachian Plateau is somewhat an artifact of the massive agricultural abandonment that has taken place over the past 80 or so years. The fact that most of the abandonment has already taken place is unique to our time. Most of these second-growth stands are maturing and being harvested (diameter-limit cuts and high-grading). They will not come back to yellow-poplar, without clearcutting (which is seldom done).

Native Uncharacteristic Conditions

American Chestnut was once an occasional canopy 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	UN	UN	UN	UN	UN	UN	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 5 Early Development 1 - All Structures

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ANGE	Andropogon gerardii	Big bluestem	Upper
SCSC	Schizachyrium scoparium	Little bluestem	Upper
CAREX	Carex	Sedge	Upper

Description
Class A is grassland prairie maintained by frequently recurring fire. 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 15 Mid Development 1 - Open

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAL	Quercus alba	White oak	Upper
QURU	Quercus rubra	Northern red oak	Upper
CAREX	Carex	Sedge	Lower
QUVE	Quercus velutina	Black oak	Upper

Description
This is an early tree regeneration (seedling; root and stump sprouts) phase; fire frequency is about 10-15yrs. 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 mid-seral, open oak forest. Occasional fires of high severity will top-kill all trees moving the community back to the early-seral class. Currently, old fields of anthropogenic origin convert to Virginia pine (Pinus virginiana), red oak, white oak, tuliptree, red maple and hackberry in the absence of fire (C. Emanuel pers. comm.).

Maximum Tree Size Class
Sapling >4.5ft; <5"DBH

Class C 57 Mid Development 2 - Open

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAL	Quercus alba	White oak	Upper
QURU	Quercus rubra	Northern red oak	Upper
QUVE	Quercus velutina	Black oak	Upper
ACER	Acer	Maple	Upper

Description
This class is defined as open oak woodlands with a fire return interval of 5-15yrs. The canopy closure is less than 60%. This community quite commonly experiences frequent surface fires and mixed fires which maintain this class.

Maximum Tree Size Class
Large 21-33"DBH

Class D 21 Late Development 1 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAL	Quercus alba	White oak	Upper
QURU	Quercus rubra	Northern red oak	Upper
ACER	Acer	Maple	Upper
QUVE	Quercus velutina	Black oak	Upper

Description
Class D is defined as closed oak forest. Understories of oak seedlings exist.

Maximum Tree Size Class
Large 21-33"DBH

Class E 2 Late Development 2 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ACRU	Acer rubrum	Red maple	Upper
ACSA3	Acer saccharum	Sugar maple	Upper
LITU	Liriodendron tulipifera	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.

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	Late1:CLS	100
Late1:CLS	101	Late1:CLS	999
Late2:CLS	101	Late2:CLS	999

Probabilistic Transitions

Disturbance	Disturbance	Moves	Disturbance	Return	Reset Age to New	Years Since

Type	occurs In	vegetation to	Probability	Interval (yrs)	Class Start Age After Disturbance?	Last Disturbance
Replacement Fire	Early1:ALL	Early1:ALL	0.33	3	Yes	0
Replacement Fire	Mid1:OPN	Early1:ALL	0.067	15	Yes	0
Mixed Fire	Mid1:OPN	Mid1:OPN	0.1	10	No	0
Alternative Succession	Mid2:OPN	Late1:CLS	1	1	Yes	25
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
Surface Fire	Mid2:OPN	Mid2:OPN	0.2	5	No	0
Alternative Succession	Late1:CLS	Late2:CLS	1	1	No	50
Replacement Fire	Late1:CLS	Early1:ALL	0.002	500	Yes	0
Mixed Fire	Late1:CLS	Mid1:OPN	0.005	200	Yes	0
Wind or Weather or Stress	Late1:CLS	Mid2:OPN	0.0075	133	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	Early1:ALL	0.001	1000	Yes	0
Wind or Weather or Stress	Late2:CLS	Mid1:OPN	0.0075	133	Yes	0
Surface Fire	Late2:CLS	Late2:CLS	0.01	100	No	0

References

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

Braun, E.L. 1961. The woody plants of Ohio: Trees, shrubs and woody climbers native, naturalized and escaped. Hafner Publishing Company, NY. 362 pp.

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

Drury, S.A. and J.R. Runkle. 2006. Forest vegetation change in southeast Ohio: Do older forests serve as useful models for predicting the successional trajectory of future forests? Forest Ecology and Management 223:200-210.

Fike, J. 1999. Terrestrial and palustrine plant communities of Pennsylvania. Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, Harrisburg, PA.

Fowells, H.A. 1965. Silvics of Forest Trees of the United States. Ag. Hdbk. 271. USDA Forest Service, Washington, DC .

Glasgow, L.S. and G.R. Matlack. 2007. Prescribed burning and understory composition in a temperate deciduous forest, Ohio, USA. Forest Ecology and Management 238:54-64.

Goebel, P.C., D.M. Hix and M. Semko-Duncan. 2005. Composition and structure of two old-growth forest ecosystem types of southeastern Ohio. Ohio Journal of Science 105:8-16.

Greller, A.M. 1988. Deciduous forest. 288-316. In: Barbour, M.G. and W.D. Billings, eds. North American terrestrial vegetation. Cambridge University Press, NY.

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

McEwan, R.W., T.F. Hutchinson, R.P. Long, D.R. Ford and B.C. McCarthy. 2007. Temporal and spatial patterns in fire occurrence during the establishment of mixed-oak forests in eastern North America. Journal of Vegetation Science 18:655-664.

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

Rinkes, Z.L. and B.C. McCarthy. 2007. Ground layer heterogeneity and hardwood regeneration in mixed oak forest. Applied Vegetation Science 10:279-284.

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

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

US Forest Service, Eastern Region. 1995. Chapter 16 Ecological Subregions of the United States:Section 221E--Southern Unglaciated Allegheny Plateau: http://www.fs.fed.us/land/pubs/ecoregions/ch16.html#221E On-line document.