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An Old-Growth Definition for Xeric Pine and Pine-Oak Woodlands

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A Section of the Old-Growth Definition Series

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Preface

Old growth is widely acknowledged today as an essential part of managed forests, particularly on public lands. However, this concept is relatively new, evolving since the 1970's when a grassroots movement in the Pacific Northwest began in earnest to define old growth. In response to changes in public attitude, the U.S. Department of Agriculture, Forest Service, began reevaluating its policy regarding old-growth forests in the 1980's. Indeed, the ecological significance of old growth and its contribution to biodiversity were apparent. It was also evident that definitions were needed to adequately assess and manage the old-growth resource. However, definitions of old growth varied widely among scientists. To address this discrepancy and other old-growth issues, the National Old-Growth Task Group was formed in 1988. At the recommendation of this committee, old growth was officially recognized as a distinct resource by the Forest Service, greatly enhancing its status in forest management planning. The committee devised "The Generic Definition and Description of Old-Growth Forests" to serve as a basis for further work and to ensure uniformity among Forest Service Stations and Regions. Emphasis was placed on the quantification of old-growth attributes.

At the urging of the Chief of the Forest Service, all Forest Service Stations and Regions began developing old-growth definitions for specific forest types. Because the Southern and Eastern Regions share many forest communities (together they encompass the entire Eastern United States), their efforts were combined, and a cooperative agreement was established with The Nature Conservancy for technical support. The resulting project represents the first large-scale effort to define old growth for all forests in the Eastern United States. This project helped bring the old-growth issue to public attention in the East.

Definitions will first be developed for broad forest types and based mainly on published information and so must be viewed accordingly. Refinements will be made by the Forest Service as new information becomes available. This document represents 1 of 35 forest types for which old-growth definitions will be drafted.

In preparing individual old-growth definitions, authors followed National Old-Growth Task Group guidelines, which differ from the standard General Technical Report format in two ways—the abstract (missing in this report) and the literature citations (listed in Southern Journal of Applied Forestry style). Allowing for these deviations will ensure consistency across organizational and geographic boundaries.

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Introduction

This old-growth type differs from the general concept of old growth, which is generally viewed as multicanopied and with a luxuriant understory. This type occurs in more hostile environments, such as exposed ridges and southern slopes, and often the midcanopy layers below the overstory are missing. This type often occurs as relatively small, isolated fragments because it is usually restricted to minor topographic features. These differences make the xeric pine and pine-oak woodlands unique among the old-growth types.

Description of Forest Type Group

General Location

Xeric pine and pine-oak forests and woodlands are found throughout most of the Eastern United States, from southern Missouri to northeast Texas eastward to the Atlantic coastline from southern Maine to South Carolina. The chief physiographic provinces containing these forests and woodlands are the Ozark Plateau, Ouachita Mountains, Interior Low Plateau, Appalachian Plateau, Ridge and Valley, Blue Ridge, Piedmont, West Gulf Coastal Plain, Embayed Coastal Plain, and southern New England.

Site Characteristics

These communities normally exist on dry, infertile sites with strongly acidic soils. Xeric site conditions result from (1) low precipitation, (2) limited moisture absorption/ retention (exposed bedrock, steep slopes, coarse-textured soils, rocky soils, shallow soils), and/or (3) high evapotranspiration rates (southern exposures). Most xeric pine and pine-oak forests and woodlands occur on ridgetops and south-facing upper slopes in the mountains or on excessively drained, sandy uplands in gentle terrain (e.g., Piedmont).

Species

Principal species of these xerophytic communities include pitch pine (*Pinus rigida* Mill.), Virginia pine (*P. virginiana* Mill.), shortleaf pine (*P. echinata* Mill.), Table Mountain pine (*P. pungens* Lamb.), and chestnut oak (*Quercus prinus* L.). Associated species are scarlet oak (*Q. coccinea* Muenchh.), black oak (*Q. velutina* Lam.), blackjack oak (*Q. marilandica* Muenchh.), post oak (*Q. stellata* Wangenh.), northern red oak (*Q. rubra* L.), southern red oak (*Q. falcata* Michx.), white oak (*Q. alba* L.), and pignut hickory (*Carya glabra* Mill.). Understories consist predominantly of ericaceous shrubs, and within its range, bear oak (*Q. ilicifolia* Wangenh.).

Site Disturbances

Due to the prevailing xeric conditions, these forests and woodlands have had frequent fires. Before European settlement, most fires were probably low-intensity, surface burns, although occasional catastrophic canopy fires undoubtedly occurred in some stands. On sites where nutrients and moisture are not extremely limiting, periodic burns are usually necessary to maintain these early successional forests, especially the pines (*Pinus* spp.). Over many decades, accumulation of dead biomass can predispose these forests to catastrophic fire. However, even in the absence of fire, successional changes are normally restricted (possibly ending with oak domination) because most sites are infertile and dry.

Distinguishing Features

Distinctive differences exist in this group east and west of the Mississippi River. All the principal species are found east of the river; shortleaf pine is the only pine species occurring west of the river; and chestnut oak is confined to east of the river.

The occurrence of pines in the Appalachian Highlands is influenced by elevation, aspect, and exposure, even on xeric sites. In the Great Smoky Mountains, Whittaker (1956) found that Virginia and shortleaf pines were concentrated at low elevations and were scarce above 2,500 feet [762 meters (m)]; pitch pine dominated between 2,200 and 3,200 feet (671 and 975 m); and Table Mountain pine was the most abundant pine at higher elevations. Table Mountain pine occurred most commonly between elevations of 1,000 and 4,000 feet (305 and 1219 m); occurrences above 4,000 feet (1219 m) were confined to its southern range in North Carolina and Tennessee (Zobel 1969). Golden (1981) found that communities of pitch pine and Table Mountain pine tended to occur on exposed ridges, upper slopes, or steep south-southwest slopes at middle to low elevations, less than 4,100 feet (1250 m), in the central Great Smoky Mountains. Racine (1966) observed that the most important factor affecting the dominance of these pine species in the Blue Ridge escarpment was ridge width; however, pine dominance was also influenced by ridge prominence in relation to surrounding topography and a southern exposure. Racine (1966) reported that ridge orientation was also important; on east-west ridges pine communities would extend down the south slopes almost to cove forests, but on north-south ridges the pines were confined to a narrow strip on the crest. Hack and Goodlett (1960) reported that pitch pine and Table Mountain pine in the upper Shenandoah Valley were restricted to noses, ridges, and convex slopes. In the Interior Highlands of Arkansas, Oklahoma, and Missouri, xeric communities of shortleaf pine are found up to 2,000 feet (610 m) on south-facing slopes and ridges that are harsh, refractory sites (Eyre 1980).

Associated Society of American Foresters Cover Types:

43—bear oak (in part)
45—pitch pine (in part)
75—shortleaf pine
76—shortleaf pine-oak
78—Virginia pine-oak
79—Virginia pine

Old-Growth Conditions

Living Tree Component

Because of the poor growing conditions, tree size and other old-growth characteristics of xeric pine and pine-oak woodlands are vastly different from other old-growth types; e.g., mixed mesophytic (Martin 1991). For instance, Stahle and others (1985) described the vegetation on a steep, xeric, south-facing slope of the Roaring Branch Research Natural Area in Arkansas as open with few overstory trees and many canopy gaps. Most shortleaf pines on this site were large, scattered trees. Stahle and others (1985) also characterized a xeric shortleaf pine forest in Hot Springs National Park as rather open with shortleaf the most common species but with abundant white oak, various hickories (*Carya* spp.), and other hardwoods. Whittaker (1956) portrayed Table Mountain pine stands in the Great Smoky Mountains as having an open pine canopy above a dense, low, ericaceous shrub layer.

Because this forest type group includes several species and covers a wide geographic area, stand characteristics also differ. Tree density runs from about 45 trees per acre [11 per hectare (ha)] for Table Mountain pine to more than 300 per acre (741 per ha) for shortleaf pine in the Ouachita Mountains (table 1). Martin (1991) stated that old-growth basal areas on dry sites would probably be less than 109 square feet per acre (25 m^2/ha).

The average age of large trees in table 1 was taken as the midpoint between the mature age and maximum age given by Hepting (1971) for each species; values range from 140 to 200 years. Pitch pine, Table Mountain pine, and Virginia pine will usually grow to no more than about 15 inches [38 centimeters (cm)] in diameter at breast height (d.b.h.) on xeric sites in the Great Smoky Mountains (Whittaker 1956). But shortleaf pine in the Interior Highlands may reach 25 inches (64 cm) in d.b.h. on these sites (Fountain and Sweeney 1985).

Limited information is available on the number of 4-inch (10-cm) diameter classes. Whittaker (1956) showed four 4-inch (10-cm) diameter classes in a stand table for Table Mountain pine in the Great Smoky Mountains. A sample of south-facing midslopes in the Roaring Branch Research Natural Area (Fountain and Sweeney 1985) revealed six classes for shortleaf pine and four classes for hardwoods.

Dead Tree Component

The only information available about dead tree components involves glade and decadent stands in the Hot Springs National Park (Johnson and Schnell 1985). The glade type occurs as narrow strips on ridgetops and steep, south-facing slopes with thin, rocky soils and rock outcrops. The overstory is composed of pines, oaks, and hickories; the understory is primarily grass with some herbaceous cover. The decadent stands have medium-to-heavy fuel loads and are composed of large, old, shortleaf pine trees scattered among smaller pines and hardwoods. Most of the large

downed and dead woody material and snags are pine. Some stands have a large amount of dead material, probably because they accumulated more biomass than the glades and went longer without fire.

Other Components

In the Great Smoky Mountains, Whittaker (1956) observed that common associates of Virginia pine at lower elevations were chestnut oak, scarlet oak, white pine (*P. strobus* L.), blackgum (*Nyssa sylvatica* Marsh.), black oak, and white oak. Shrub-layer coverage ranges from 10 to 40 percent; common species are *Kalmia latifolia* L., *Vaccinium vacillans* Torr., *V. stamineum* L., *Ilex montana* var. *beadlei* Ashe, and *Smilax* spp. The herb-layer coverage is only 2 to 10 percent with *Andropogon scoparius* Michx. being the most prevalent species. Chestnut oak is a common associate of pitch pine along with other species. Shrub coverage is greater, from 40 to 70 percent, and the dominant species are *K. latifolia*, *V. vacillans*, and *V. hirsutum* Buckl. Herb coverage is 5 to 20 percent with *A. scoparius* Michx., *Pteridium aquilinum* var. *latisculum* Desvaux, *Epigaea repens* L., and *Gaultheria procumbens* L. the most common species. At high elevations, pitch pine, scarlet oak, chestnut oak, and blackgum are associates of Table Mountain pine. *Kalmia latifolia* and *Vaccinium* spp. dominate the shrub layer, which ranges from 60 to 90 percent coverage. *Galax aphylla* L., *E. repens* L., and *G. procumbens* L. are the important species of the herb layer, which ranges from 5 to 20 percent coverage.

In addition to shortleaf pine, the south-facing slopes at Hot Springs National Park (Dale and Watts 1980) support post oak, blackjack oak, and black hickory (*C. texana* Buckl.). Ground cover is sparse but comprises a variety of species; dominants are *Tephrosia virginiana* (L.) Persoon and *Brachyelytrum erectum* (Schreb.) Beauv.

In Le Flore County, Oklahoma, Johnson (1986) found several species characteristic of xeric sites associated with shortleaf pine on south-facing slopes. *Vaccinium vacillans* Torr. dominated the shrub layer.

On the Roaring Branch Research Natural Area in Arkansas, Fountain and Sweeney (1985) found that white oak, northern red oak, black oak, and mockernut hickory [*C. tomentosa* (Poir.) Nutt.] were common associates of shortleaf pine on a south-facing midslope. The shrub layer was dominated by *V. arboreum* Marsh., *V. vacillans*, and *Q. alba*. Typical herbaceous species were *Panicum* spp. L., *Danthonia spicata* (L.) Beauv., and *Desmodium* spp. Desvaux.

Forest Dynamics and Succession

Xeric pine and pine-oak woodlands occur primarily in small patches that have survived settlement, mining, logging, farming, grazing, and other activities that have greatly affected the more fertile and accessible forest land. Typically, they occur on steep slopes, ridgetops, and less fertile sites, thus discouraging human exploitation. Confined to these rugged locations, most old-growth xeric pine and pine-oak woodlands are small and scattered rather than in large contiguous blocks. Stahle and others (1985) stated that some of the old growth still found in the Eastern United States occurs on these sites as small pockets of relict stands.

Because of greater productivity and easier access, forests in the Piedmont and Coastal Plain have been so extensively logged and cleared that old-growth forests, including xeric pine and pine-oak woodlands, are rare. Jones (1988) described the xeric sites in the South Carolina Piedmont where this old-growth type could occur as high-landscape positions, southerly and westerly aspects, and heavy clay-textured soils or rocks close to the soil surface. The driest sites were on exposed ridge flats and upper slopes of any aspect with soils that had a heavy clay subsurface within 1.0 feet (0.3 m) of the surface or bedrock within 2.0 to 2.3 feet (0.6 to 0.7 m) of the surface. Ward (1984) described xeric sites in the east Texas Coastal Plain as rounded to flat-topped hills with sandy, porous soils.

Whether this forest type group is self-sustaining or is a seral stage is debatable. Even the historic role of fire is not completely understood. Whittaker (1956) suggested that intense fires on xeric sites in the Great Smoky Mountains might produce an even-aged pine stand. As this pine stand ages, mortality creates small openings where a new generation of pine becomes established. Whittaker (1956) speculated that these successive waves of new seedlings might be the reason for bimodal distributions in these stands. He also stated that fire alone does not produce these pine stands. Barden and Woods' (1976) results indicate that not every lightning fire is intense enough to eliminate the existing forest canopy in the Great Smoky Mountains; thus, most lightning fires would not necessarily initiate new pine reproduction. Harmon and others (1983) found in the Great Smoky Mountains National Park that occurrence of both natural and anthropogenic fires increased with elevation, but most of the lightning fires occurred on xeric sites. Barden (1977) found that Table Mountain pine maintained itself for 87 years without fire on Looking Glass Mountain in North Carolina. Zobel (1969) suggested that Table Mountain pine might be self-sustaining on rock outcrops or shale slopes where hardwood species grow poorly. The pines might

Table 1 (English units)[a]—Old-growth attributes for xeric pine and pine-oak forests and woodlands

Quantifiable attribute	Value		No. of stands[b]	References
	Range	Mean		
Stand density (no./acre; ≥4-in d.b.h.)				
Hot Springs National Park				Dale and Watts 1980
Shortleaf pine	234-434	340.0	NA	
Hardwoods	84-167	112.0	NA	
Oklahoma				Johnson 1986
Shortleaf pine and hardwoods (>2-in d.b.h.)	NA	253.0	NA	
Roaring Branch RNA				Fountain and Sweeney 1985
Shortleaf pine	NA	56.0	1	
Hardwoods	NA	169.0	1	
Great Smoky Mountains				Whittaker 1956
Table Mountain pine	NA	45.0	NA	
Stand basal area (ft^2/acre; ≥4-in d.b.h.)				
Hot Springs National Park				Dale and Watts 1980
Shortleaf pine	36.7-76.7	56.7	NA	
Hardwoods	18.4-21.7	20.0	NA	
Oklahoma				Johnson 1986
Shortleaf pine and hardwoods (>2-in d.b.h.)	NA	94.0	NA	
Roaring Branch RNA				Fountain and Sweeney 1985
Shortleaf pine	NA	30.0	1	
Hardwoods	NA	51.0	1	
Great Smoky Mountains				Whittaker 1956
Table Mountain pine	NA	24.4	NA	
Age of large trees (years)				Hepting 1971
Shortleaf pine	NA	200.0	NA	
Pitch pine	NA	150.0	NA	
Table Mountain pine	NA	200.0	NA	
Virginia pine	NA	140.0	NA	
Number of 4-in size classes (≥4-in d.b.h.)				
Roaring Branch RNA				Fountain and Sweeney 1985
Shortleaf pine	NA	6.0	1	
Hardwoods	NA	4.0	1	
D.b.h. (or maximum d.b.h.) of largest trees (inches)[c]				
Shortleaf pine	22-25	23.0	1	Fountain and Sweeney 1985
Pitch pine	12-15	NA	NA	Whittaker 1956
Table Mountain pine	10-15	NA	NA	Whittaker 1956
Virginia pine	10-15	NA	NA	Whittaker 1956
Standing snags (tons/acre; ≥3-in d.b.h.)				
Hot Springs National Park				Johnson and Schnell 1985
Glade	NA	3.5	NA	
Decadent stand	NA	13.1	NA	
Downed logs (tons/acre)				
Hot Springs National Park				Johnson and Schnell 1985
Glade	NA	.1	NA	
Decadent stand	NA	4.2	NA	
Decadent trees[d] (no./acre; ≥4-in d.b.h.)	NA	NA	NA	NA
Canopy layers (no.)[e]	NA	NA	NA	NA
Canopy in gaps (percent)	NA	NA	NA	NA
Other features	NA	NA	NA	NA

[a] NA in the table denotes that information is not available.
[b] Number of stands may not equal the number of citations.
[c] Includes dominant and codominant trees that make up the upper canopy.
[d] Includes deformed, bole-scarred, spike-topped, and wind-damaged trees.
[e] May be bimodal.

Table 1 (metric units)[a]—Old-growth attributes for xeric pine and pine-oak forests and woodlands

Quantifiable attribute	Value		No. of stands[b]	References
	Range	Mean		
Stand density (no./acre; ≥10-cm d.b.h.)				
Hot Springs National Park				Dale and Watts 1980
Shortleaf pine	578-1072	840.0	NA	
Hardwoods	208- 413	277.0	NA	
Oklahoma				Johnson 1986
Shortleaf pine and hardwoods (>5-cm d.b.h.)	NA	625.0	NA	
Roaring Branch RNA				Fountain and Sweeney 1985
Shortleaf pine	NA	138.0	1	
Hardwoods	NA	418.0	1	
Great Smoky Mountains				Whittaker 1956
Table Mountain pine	NA	111.0	NA	
Stand basal area (m^2/ha; ≥10-cm d.b.h.)				
Hot Springs National Park				Dale and Watts 1980
Shortleaf pine	8.4-17.6	13.0	NA	
Hardwoods	4.2- 5.0	4.6	NA	
Oklahoma				Johnson 1986
Shortleaf pine and hardwoods (>5-cm d.b.h.)	NA	21.6	NA	
Roaring Branch RNA				Fountain and Sweeney 1985
Shortleaf pine	NA	6.9	1	
Hardwoods	NA	11.7	1	
Great Smoky Mountains				Whittaker 1956
Table Mountain pine	NA	5.6	NA	
Age of large trees (years)				Hepting 1971
Shortleaf pine	NA	200.0	NA	
Pitch pine	NA	150.0	NA	
Table Mountain pine	NA	200.0	NA	
Virginia pine	NA	140.0	NA	
Number of 10-cm size classes (≥10-cm d.b.h.)				
Roaring Branch RNA				Fountain and Sweeney 1985
Shortleaf pine	NA	6.0	1	
Hardwoods	NA	4.0	1	
D.b.h. (or maximum d.b.h.) of largest trees (cm)[c]				
Shortleaf pine	56-64	58.0	1	Fountain and Sweeney 1985
Pitch pine	30-38	NA	NA	Whittaker 1956
Table Mountain pine	25-38	NA	NA	Whittaker 1956
Virginia pine	25-38	NA	NA	Whittaker 1956
Standing snags (tons/ha; ≥7.6-cm d.b.h.)				
Hot Springs National Park				Johnson and Schnell 1985
Glade	NA	7.8	NA	
Decadent stand	NA	29.5	NA	
Downed logs (tons/ha)				
Hot Springs National Park				Johnson and Schnell 1985
Glade	NA	.3	NA	
Decadent stand	NA	9.4	NA	
Decadent trees[d] (no./ha; ≥10-cm d.b.h.)	NA	NA	NA	NA
Canopy layers (no.)[e]	NA	NA	NA	NA
Canopy in gaps (percent)	NA	NA	NA	NA
Other features	NA	NA	NA	NA

[a] NA in the table denotes that information is not available.
[b] Number of stands may not equal the number of citations.
[c] Includes dominant and codominant trees that make up the upper canopy.
[d] Includes deformed, bole-scarred, spike-topped, and wind-damaged trees.
[e] May be bimodal.

maintain themselves best where understory hardwoods and shrubs do not prevent the establishment and development of pine reproduction. Indeed, fires help keep competition in check. So it may not be necessary for the sparse pine overstory to be eliminated for pine reproduction to develop, particularly with understory burning. Tornadoes and wind storms may also create openings in certain regions (Turner 1935). Ward (1984) described xeric forests (not necessarily old growth) in hilly, dry uplands in east Texas as open and two-storied and speculated that dense understories might prevent establishment of seedlings of overstory species. In the past, fire may have kept understory densities lower.

The limited, scattered occurrence of this type probably precludes setting aside an area exclusively for old growth. Rather, old-growth xeric pine and pine-hardwood forests and woodlands will probably be managed in areas that have more than one type, especially where oak dominates. Because it occurs in small tracts in large areas, setting a minimum area for management may not be appropriate.

Representative Old-Growth Stands

Areas where representative old-growth stands may appear include:

- Hot Springs National Park, Arkansas
- Lake Winona Research Natural Area, Ouachita National Forest, Arkansas
- Magazine Mountain, Ozark National Forest, Arkansas
- Roaring Branch Research Natural Area, Ouachita National Forest, Arkansas
- Marshall Forest Preserve, near Rome, Georgia
- Alley Spring Hollow, Shannon County, Missouri—50 acres (20.3 ha)
- Big Spring Towering Pines, Carter County, Missouri—150 acres (60.8 ha)
- Botkins Pine Woods, Ste. Genevieve County, Missouri—30 acres (12.2 ha)
- Hawe's Recreation Area, Carter County, Missouri—15 acres (6.1 ha)
- Hickory Canyons, Ste. Genevieve County, Missouri—30 acres (12.2 ha)
- Highway T Forest, Phelps County, Missouri—20 acres (8.1 ha)
- Johnson Tract, Wayne County, Missouri—30 acres (12.2 ha)
- Kaintuck Hollow, Phelps County, Missouri—15 acres (6.1 ha)
- Lovers Leap, Howell County, Missouri—15 acres (6.1 ha)
- Paddy Creek Wilderness Area, Texas County, Missouri— 50 acres (20.3 ha)
- Peter A. Eck Tract, Texas County, Missouri—230 acres (93.2 ha)
- Prairie Hollow, Shannon County, Missouri—13 acres (5.3 ha)
- Rocky Falls, Shannon County, Missouri—30 acres (12.2 ha)
- Spring Valley Branch, Carter County, Missouri—15 acres (6.1 ha)
- Twin Springs Woods, Ripley County, Missouri—30 acres (12.2 ha)
- Virgin Pine Forest, Shannon County, Missouri—47 acres (19.0 ha)
- Great Smoky Mountains National Park, North Carolina and Tennessee
- Linville Gorge, Pisgah National Forest, North Carolina.

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The old-growth characteristics of xeric pine and pine-oak woodlands are summarized from a survey of the available scientific literature. This type occurs throughout the South and is usually found as small inclusions on ridgetops and south-facing slopes in the mountains or on excessively drained, sandy uplands in gentle terrain. Historically, this type has had frequent fires. The overstory is rather open, and ericaceous shrubs commonly form the understory.

Keywords: Chestnut oak, downed logs, ericaceous shrubs, pitch pine, shortleaf pine, snags, Table Mountain pine, Virginia pine, xerophytic communities.

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