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An Old-Growth Definition for Sand Pine Forests

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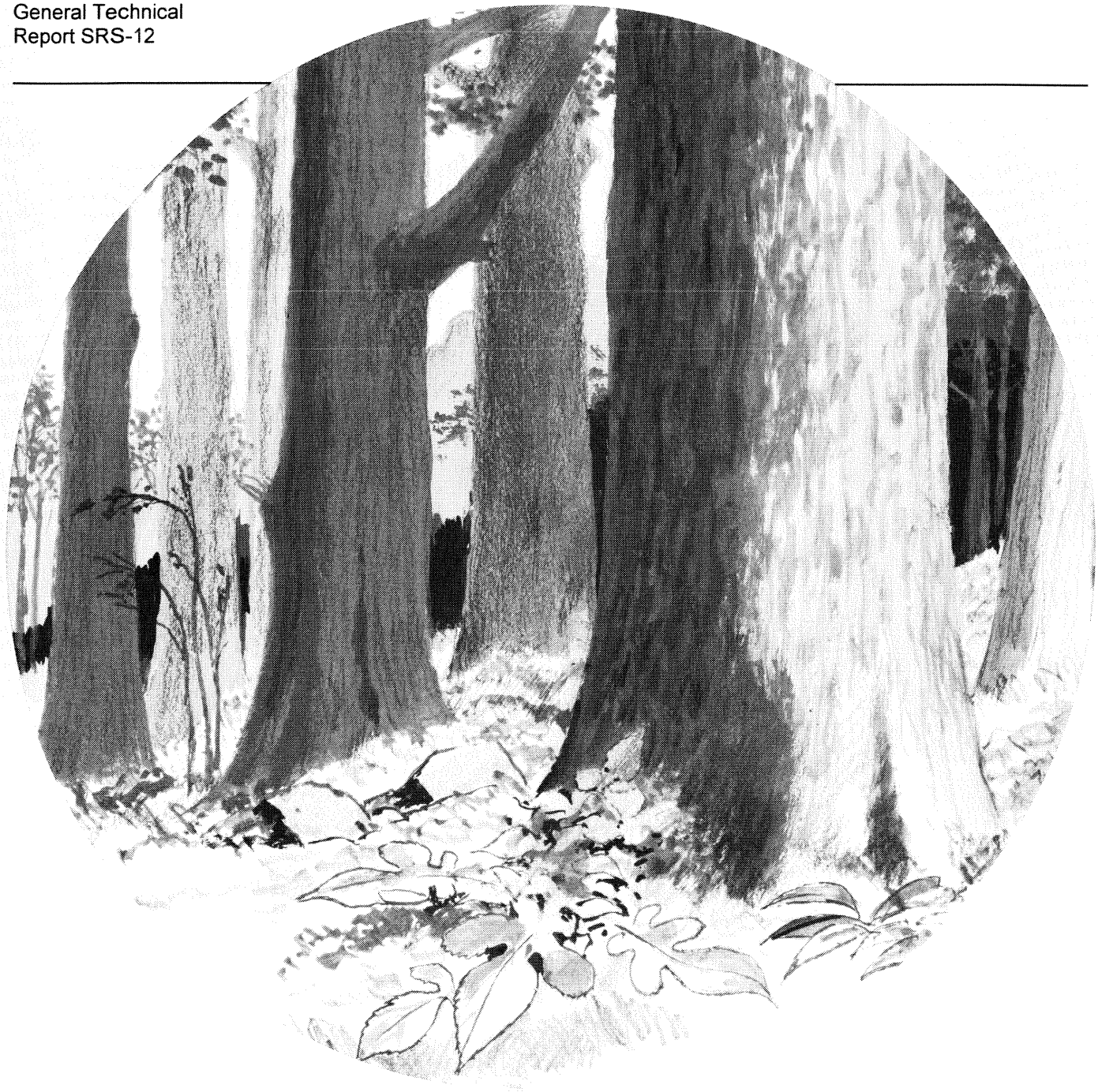

A Section of the Old-Growth Definition Series

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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

Sand pine scrub, Society of American Foresters cover type 69 (Eyre 1980), grows on deep, droughty, infertile sands of marine and aeolian origin. Water and wind formed these features as sea levels fluctuated during past glacial and interglacial periods (Kurz 1942, Laessle 1958, Brooks 1972). Because of washing and sorting during transport and deposition, soil parent material was nearly pure quartz sand (Laessle 1958). This produced soils that are almost exclusively entisols and mostly Quartzipsamments (Myers 1990), typified by the Astatula, Lakeland, Paola, and St. Lucie soil series.

The Ocala variety (*Pinus clausa* var. *clausa* D.B. Ward) of sand pine is native to the central ridge of Florida and a strip of old dunes stretching from St. John's County south to the northern portion of Dade County on the east coast and from near Cedar Key south to Naples on the west coast (Small 1921, Harper 1927, Myers 1990). Choctawhatchee sand pine (*P. clausa* var. *immuginata* D.B. Ward) is the dominant tree in scrubs along the Gulf Coast (including off-shore islands) of northwest Florida from the Apalachicola River westward into Alabama. The largest concentration of sand pine is the interior scrub, which occupies about 250,000 acres (ac) [101,250 hectares (ha)] on the Ocala National Forest (Brendemuehl 1990).

Sand pine is native to areas that have hot, humid summers, somewhat dry winters, and a long growing season (269 to 312 days). Precipitation is abundant, 53.0 to 60.0 inches per year [1345 to 1525 millimeters (mm) per year]; July is the wettest and May the driest month. Because of the low moisture-holding capacity of the soils, drought conditions can exist within 2 weeks of a heavy rainfall. Surface temperatures of exposed soils can also be extreme, reaching 140 °F (60 °C) on summer days (Burns and Hebb 1972).

Ocala sand pine forests have an overstory of even-aged sand pine with twisted and leaning trunks growing over an understory of evergreen shrubs (Myers 1990). Typical understory species include myrtle oak (*Quercus myrtifolia* Willd.), sand live oak [*Q. virginiana* var. *geminata* (Small) Sarg.], Chapman oak (*Q. chapmanii* Sarg.), turkey oak (*Q. laevis* Walt.), rusty lyonia [*Lyonia ferruginea* (Walt.) Nutt.], rosemary (*Ceratiola ericoides* Michx.), scrub palmetto (*Sabal etonia* Swingle ex Nash), and saw-palmetto [*Serenoa repens* (Bartr.) Small]. Because of dry soils and competition from the sand pine overstory and understory shrubs, herbs and grasses are very sparse in mature scrub habitats. Typical species include beak-rush (*Rhynchospora megalocarpa* Vahl), milk-peas (*Galactia* spp.), and bluestem (*Andropogon* spp.). Lichens (*Cladonia* spp.) form extensive patches on the forest floor.

Because of its sparse ground cover and compacted litter layer, Ocala sand pine scrub seldom burns. Periodically (every 10 to 100 years), usually during the spring drought, high winds and extreme conditions result in high-intensity fires. These fires burn off the understory and kill the sand pine overstory (Myers 1990). These fires also open the many serotinous cones contained in the crowns of the sand pine, releasing the seed for establishment of the next stand. Choctawhatchee sand pine trees produce cones that open at maturity, so catastrophic fires are not required for regeneration. Overstory trees are more likely replaced as a result of blow-down from periodic tropical storms.

These sand pine scrub communities are unique habitats with a mix of species that occur nowhere else (Christman and Judd 1990). Although most of the endemic species thrive in the open scrub when sand pine trees are just seedlings, the old-growth stage is still an important part of the ecosystem.

Old-growth sand pine [*P. clausa* (Chapm. ex Engelm.) Vasey ex Sarg.] stands were inventoried and a set of attributes developed to characterize what constitutes old growth for this forest ecosystem. Preliminary sampling indicated that there was a change in stand structure around age 50 years for Ocala sand pine. Based on this information, three stands of Ocala sand pine were randomly chosen from all the stands on the Ocala National Forest with an average age of 50 years or more. Within each stand, three circular plots 0.25 ac (0.1 ha) were established. The species, diameter, and crown class were recorded for all trees 4 inches [10 centimeters (cm)] or larger within these plots.

Snags and stumps were also recorded. Age and height were determined for the two largest sand pines in each plot as were the number of canopy layers and their height range. The species and diameter of all trees 0.8 inches (2.0 cm) to 4.0 inches (10.0 cm) in diameter (tall shrub layer) were recorded from a 0.025-ac (0.01-ha) circular plot at the center of each larger plot. Subplots of 10.8 square feet [1.0 square meter (m)] were established 9.9 feet (3.0 m) from the plot center in each of the four cardinal directions. The number of stems less and greater than 3.3 feet (1.0 m) tall was recorded by species for all woody vegetation less than 0.8 inches (2.0 cm) in diameter within these plots. The number of herbaceous stems on these subplots was also recorded by species. The percentage cover of lichens was estimated by ocular comparison to templates of known coverage. Depth of the forest floor was measured at the center of each subplot. Cover of downed woody material greater than 4.0 inches (10.0 cm) in diameter and gaps in the overstory canopy were determined along two 49.0-feet (15.0-m) line transects between the large plot boundaries.

Three Choctawhatchee sand pine stands were also sampled. Two of the sample stands were located on Eglin Air Force Base, and the third was on Fred Gannon State Park located near Niceville, FL. Sample stands were chosen from within the historical range of the variety. Also, only stands in the interior of the cover type were used to avoid sampling a former sandhills site that had been invaded by sand pine due to a reduction in natural fires. (Because herbaceous species were more prevalent in Choctawhatchee sand pine stands, cover estimates were used rather than stem counts.)

Old-Growth Attributes

Ocala Sand Pine

Some of the paleodunes Ocala sand pine occupy are only an acre (0.4 ha) in size, but they can still develop old growth. Conversely, old growth can develop over extensive areas in the even-aged stands that follow the large fires once prevalent in the big scrub area of the Ocala National Forest.

The overstory of old-growth Ocala sand pine stands, as in younger stands, is composed entirely of sand pine (table 1). Dominant trees made up 50 percent and codominants 25 percent of the total overstory of the sample stands. Ocala sand pine is a small tree, and stands had an average tree diameter of only 7.5 inches (19.1 cm). The largest sand pines in the stands, however, had a mean diameter of 14.0 inches (35.0 cm), were more than 70.0 feet (22.0 m) tall, and averaged 55 years old. Because of the sparse stocking and small tree size, stand basal area was low, about 40.0 square feet per ac (9.0 m^2 per ha). Ocala sand pine is susceptible to root rot fungi, with mortality increasing sharply beyond age 40 years (Ross 1970). Because of this mortality, snags and canopy gaps were common in most old-growth stands. The low tree density of sample plots is not typical of all old-growth stands. A sample of 12 stands older than 60 years in the big scrub area of the Seminole District, Ocala National Forest, had an average density of 200 trees per ac (480 trees per ha).[1]

Mid-story oaks were a significant part of the old-growth vegetation, occupying the canopy gaps between the overstory sand pine. About half (56 percent) of the mid-story oaks were sand live oak, and 26 percent were myrtle oak. The mid-story oaks were nearly as large as the overstory sand pine, with an average diameter of 6.9 inches (17.5 cm). This canopy layer was typically 15.0 to 25.0 feet (4.6 to 7.6 m) tall. Sapling-size oaks formed a tall shrub layer of moderate density 10.0 to 15.0 feet (3.0 to 4.6 m) in height. This layer was a mixture of myrtle, Chapman, and sand live oaks, mostly of small diameter (table 2). Beneath the tall shrubs was a sparse understory of mostly woody species, a few scattered herbs, and some lichens (table 3). Sand pine seedlings and saplings were rare in these old-growth stands. The forest floor was thin with an average depth of 1.7 inches (4.4 cm).

No indicator species are specific to old-growth Ocala sand pine stands. These stands contain the same mix of species found in nearly all stands older than 20 years. The main indicators of old growth are the size and age of the sand pine overstory, and the presence of large, mid-story oaks, canopy gaps, and numerous snags. Composition of the mid-story, tall shrub, and understory layers may vary in other locations, especially in isolated scrubs such as those of the Lake Wales Ridge and near coastal areas. Structure and physiognomy, however, will remain similar for old-growth Ocala sand pine stands across most of its range. On some extremely dry sites, however, even the sand pine is stunted and sparse. Old-growth Ocala sand pine on these areas will not look like the typical stands described here.

[1] Personal communication. 1996. Janet Hinchee, Silviculturist, Ocala National Forest, Seminole Ranger District, 40929 State Road 19, Umatilla, FL 32784.

Table 1 (English units)—Standardized table of old-growth attributes for Ocala sand pine forests[a b]

Quantifiable attribute	Value: Range	Value: Mean
Stand density (no./acre)		
—trees ≥4 in. d.b.h.		
Ocala sand pine	65 - 121	79.0
Dominants	38 - 53	41.0
Codominants	8 - 51	21.0
Intermediates	6 - 24	11.0
Suppressed	4 - 9	6.0
Mid-story oaks	4 - 40	25.0
Stand diameter (in)		
Ocala sand pine	6.2- 8.6	7.5
Dominants	8.6- 12.5	10.8
Codominants	6.7- 8.3	7.5
Intermediates	5.8- 6.3	6.0
Suppressed	4.9- 5.0	4.9
Mid-story oaks	5.9- 7.9	6.9
Stand basal area (ft^2/acre)		
—trees ≥4 in. d.b.h.		
Ocala sand pine	36.6- 39.2	37.5
Mid-story oaks	.4- 7.0	3.5
Age of largest trees (yrs)		
Ocala sand pine	45 - 70	55.0
Diameter of largest trees (in)		
Ocala sand pine	10 - 17	14.0
Height of largest trees (ft)		
Ocala sand pine	50 - 82	72.0
Standing snags (no./acre)		
—snags ≥4 in. d.b.h.	5 - 30	19.0
Downed logs (% cover)	.5- 5.0	2.4
Number of canopy layers	--	3.0
Canopy gaps (% cover)	5 - 75	27.0
Other features		
Stumps (no./acre)	--	3.0

[a] Number of stands is three in all attributes.
[b] The reference for all attributes is Kenneth W. Outcalt.

Table 1 (metric units)—Standardized table of old-growth attributes for Ocala sand pine forests[a b]

Quantifiable attribute	Value: Range	Value: Mean
Stand density (no./ha)		
—trees ≥10 cm d.b.h.		
Ocala sand pine	160 - 300	194.0
Dominants	93 - 130	101.0
Codominants	20 - 125	51.0
Intermediates	15 - 60	27.0
Suppressed	10 - 23	15.0
Mid-story oaks	10 - 100	62.0
Stand diameter (cm)		
Ocala sand pine	15.7- 21.8	19.1
Dominants	21.9- 31.8	27.4
Codominants	17.1- 21.0	19.0
Intermediates	14.6- 15.9	15.3
Suppressed	12.5- 12.6	12.5
Mid-story oaks	15.0- 20.0	17.5
Stand basal area (m^2/ha)		
—trees ≥10 cm d.b.h.		
Ocala sand pine	8.4- 9.0	8.6
Mid-story oaks	.1- 1.6	.8
Age of largest trees (yrs)		
Ocala sand pine	45 - 70	55.0
Diameter of largest trees (cm)		
Ocala sand pine	26 - 43	35.0
Height of largest trees (m)		
Ocala sand pine	15 - 25	22.0
Standing snags (no./ha)		
—snags≥10 cm d.b.h.	13 - 73	47.0
Downed logs (% cover)	.5- 5.0	2.4
Number of canopy layers	--	3.0
Canopy gaps (% cover)	5 - 75	27.0
Other features		
Stumps (no./ha)	--	8.0

[a] Number of stands is three in all attributes.
[b] The reference for all attributes is Kenneth W. Outcalt.

Table 2—Density of species in tall shrub layer of old-growth Ocala sand pine stands

Species	Diameter class					
	0.8-2.39 in	2.4-3.14 in	3.5-3.9 in	2.0-5.9 cm	6.0-7.9 cm	8.0-9.9 cm
	Number per acre			*Number per hectare*		
Quercus myrtifolia	162	91	9	400	225	23
Q. chapmanii	162	91	3	400	225	8
Q. virginiana var. *geminata*	93	69	12	230	170	30
Pinus clausa var. *clausa*	12	6	3	30	16	8
Lyonia ferruginea	--	--	2	--	--	5

Table 3—Abundance of major understory species found in old-growth Ocala sand pine stands

Species	English		Metric	
	>3.3 ft	≤3.3 ft	>1 m	≤1 m
	No./yd²		*No./m²*	
Shrubs				
Quercus myrtifolia	0.25	13.46	0.28	14.72
Q. virginiana var. *geminata*	.08	2.72	.08	2.97
Q. chapmanii	.18	1.63	.19	1.78
Vaccinium myrsinites	--	1.17	--	1.28
Lyonia ferruginea	.25	.51	.28	.56
Sabal etonia	.03	.43	.03	.47
Gaylussacia dumosa	--	.15	--	.17
Asimina obovata	.03	.08	.03	.08
Serenoa repens	--	.08	--	.08
Ceratiola ericoides	.03	.03	.03	.03
Persea humilis	--	.03	--	.03
Ilex opaca var. *arenicola*	--	.03	--	.03
Pinus clausa var. *clausa*	--	.03	--	.03
Herbs				
Galactia volubilis	--	.20	--	.22
Rhychospora spp.	--	.20	--	.22
Lichens (% cover)				
Cladonia spp.		7.70		7.70

Old-growth conditions will develop as stands progress beyond age 50 years; numerous examples exist on the Ocala National Forest. A good example of old-growth coastal scrub is found in the Southwest Florida Water Management District and occupies a portion of the Starkey Tract in southwestern Pasco County.

Land managers can produce old-growth by carrying some stands past the normal rotation age of 35 to 40 years. Old growth is a short-lived state, however, as stands rapidly lose their sand pine beyond 70 years (Richardson 1977). Without some disturbance from fire or harvesting, stands will eventually form xeric hammocks dominated by oaks (Laessle 1958, Veno 1976, Myers 1985). For this reason, fire needs to be allowed to occur naturally or should be introduced artificially in designated Ocala sand pine wilderness areas. This will open the area to the many endemic plants and animals that prefer the young scrub and will foster natural regeneration and establishment of even-aged sand pine stands that will later again develop into old-growth stands.

Choctawhatchee Sand Pine

The overstory of old-growth Choctawhatchee sand pine stands is almost exclusively sand pine with an occasional longleaf pine (*P. palustris* Mill.) or large sand live oak. The old-growth stands sampled were relatively well stocked, with groups of overstory sand pine and fair-sized oaks in the intervening canopy gaps (table 4). Because Choctawhatchee sand pine sheds most of its seed when cones mature, regeneration is a continuous process. This results in a large number of trees in the intermediate and suppressed crown classes (46 percent) and fewer dominants (35 percent).

Average tree diameter was 7.9 inches (20.1 cm), while dominant trees averaged more than 12.0 inches (30.0 cm) in diameter. The largest trees in the old-growth stands had a mean diameter of more than 15.0 inches (39.0 cm), were 70.0 feet (22.0 m) tall and 80 years old. Good stocking and tree size gave a basal area of 70.0 square feet per ac (16.0 square meters per ha). Snags were evident but not prevalent. Canopy gaps were numerous, occupying 25 percent of the area. Most of these gaps were the result of blow-down from a major hurricane that occurred about 20 years ago. Downed logs occurred but were not common.

Mid-story oaks were a prominent feature of the old-growth stands. More than one-third of all trees larger than 4.0 inches (10.0 cm) diameter at breast height were oaks. The average diameter of the oaks was 1.6 inches (4.0 cm) smaller than that of the sand pine, but they made up 20 percent of the total stand basal area. Sand live oak was predominant, making up 84 percent of the mid-story layer. Most of the trees in this layer were 20.0 to 35.0 feet (6.1 to 10.7 m) tall with an occasional individual 40.0 to 50.0 feet (12.2 to 15.2 m) high reaching into the lower portion of the overstory canopy. Beneath the mid-story was a shrub layer from 10.0 to 20.0 feet (3.0 to 6.1 m) tall, dominated by sand pine regeneration and oaks with lesser numbers of tree blueberry (*Vaccinium* spp.) (table 5). Ongoing work at Eglin Air Force Base indicates that the composition of these shrub layers can be quite variable.[2] The sparse understory layer was mostly woody species and a few herbs growing between patches of lichens (table 6). The thin forest floor had a mean thickness of 1.7 inches (4.3 cm).

There were no indicator species specific to old-growth Choctawhatchee sand pine stands. The best identifiers of old-growth status are the size and age of the sand pine overstory; the presence of numerous large, mid-story oaks; and the abundant canopy gaps. The amount of downed woody material is a poor indicator because it varies greatly depending on the length of time since the last major hurricane.

The ecology and dynamics of the Choctawhatchee sand pine community have been studied less than those of the Ocala scrubs. The importance and natural abundance of old-growth stands is not specifically known. However, since some old growth was part of the natural landscape, it is wise to allow for its continued existence until we better understand its function and importance to the ecosystem. To do this, land managers can produce old growth by allowing some stands to reach 70 to 100 years of age. A good example of these old-growth conditions occurs in stands at Fred Gannon State Park near Niceville, FL. Other old-growth Choctawhatchee sand pine stands occupy areas on nearby Eglin Air Force Base.

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[2] Personal communication. 1996. Stephen Seiber, Acting Chief, Natural Resources Division, Eglin Air Force Base, AFDTC/EMNF, 107 Highway 85N, Niceville, FL 32542.

Table 4 (English units)—Standardized table of old-growth attributes for Choctawhatchee sand pine forests [a b]

Quantifiable attribute	Value: Range	Value: Mean
Stand density (no./acre)		
—trees ≥4 in. d.b.h.		
Choctawhatchee sand pine	100 – 182	143.0
Dominants	31 – 68	50.0
Codominants	19 – 31	24.0
Intermediates	16 – 47	26.0
Suppressed	25 – 51	40.0
Mid-story oaks	42 – 109	74.0
Stand diameter (in)		
Choctawhatchee sand pine	7.7– 8.2	7.9
Dominants	12.5– 13.0	12.8
Codominants	8.8– 9.5	9.1
Intermediates	6.3– 7.3	6.7
Suppressed	5.1– 5.4	5.2
Mid-story oaks	5.6– 6.7	6.3
Stand basal area (ft^2/acre)		
—trees ≥4 in. d.b.h.		
Choctawhatchee sand pine	48.8– 83.6	70.1
Mid-story oaks	8.3– 32.2	17.4
Age of largest trees (yrs)		
Choctawhatchee sand pine	60 – 113	83.0
Diameter of largest trees (in)		
Choctawhatchee sand pine	12.8– 18.9	15.4
Height of largest trees (ft)		
Choctawhatchee sand pine	62 – 85	72.0
Standing snags (no./acre)		
—snags ≥4 in. d.b.h.	3 – 19	9.0
Downed logs (% cover)	1.0– 3.0	1.2
Number of canopy layers	--	3.0
Canopy gaps (% cover)	13.0– 37.0	26.0
Other features		
Stumps (no./acre)	8 – 21	12.0

[a] Number of stands is three in all attributes.
[b] The reference for all attributes is Kenneth W. Outcalt.

Table 4 (metric units)—Standardized table of old-growth attributes for Choctawhatchee sand pine forests [a b]

Quantifiable attribute	Value: Range	Value: Mean
Stand density (no./ha)		
—trees ≥10 cm d.b.h.		
Choctawhatchee sand pine	247 – 450	354.0
Dominants	77 – 167	124.0
Codominants	47 – 77	59.0
Intermediates	40 – 117	65.0
Suppressed	63 – 127	99.0
Mid-story oaks	103 – 270	183.0
Stand diameter (cm)		
Choctawhatchee sand pine	19.5– 20.7	20.1
Dominants	21.7– 33.1	32.6
Codominants	22.4– 24.0	23.2
Intermediates	16.0– 18.5	16.9
Suppressed	12.9– 13.6	13.1
Mid-story oaks	14.1– 17.0	15.9
Stand basal area (m^2/ha)		
—trees ≥10 cm d.b.h.		
Choctawhatchee sand pine	11.2– 19.2	16.1
Mid-story oaks	1.9– 7.4	4.0
Age of largest trees (yrs)		
Choctawhatchee sand pine	60 – 113	83.0
Diameter of largest trees (cm)		
Choctawhatchee sand pine	32.5– 47.9	39.2
Height of largest trees (m)		
Choctawhatchee sand pine	19 – 26	22.0
Standing snags (no./ha)		
—snags≥10 cm d.b.h.	7 – 47	22.0
Downed logs (% cover)	1.0– 3.0	1.2
Number of canopy layers	--	3.0
Canopy gaps (% cover)	13 – 37	26.0
Other features		
Stumps (no./ha)	20 – 53	30.0

[a] Number of stands is three in all attributes.
[b] The reference for all attributes is Kenneth W. Outcalt.

Table 5—Density of species in tall shrub layer of old-growth Choctawhatchee sand pine stands

Species	Diameter class					
	0.8-2.39 in	2.4-3.14 in	3.5-3.9 in	2.0-5.9 cm	6.0-7.9 cm	8.0-9.9 cm
	Number per acre			*Number per hectare*		
Pinus clausa var. *immuginata*	214	26	9	530	65	22
Quercus virginiana var. *geminata*	36	18	9	90	44	22
Vaccinium arboreum	40	13	9	100	33	22
Q. laevis	44	9	--	110	22	--
Q. laurifolia	26	4	--	65	11	--
Q. myrtifolia	36	--	--	90	--	--

Table 6—Abundance of major understory species found in old-growth Choctawhatchee sand pine stands

Species	English		Metric	
	>3.3 ft	≤3.3 ft	>1 m	≤1 m
	No./yd²		*No./m²*	
Shrubs				
Ilex vomitoria	0.10	3.6	0.10	3.3
Quercus laurifolia	.03	2.2	.03	2.0
Smilax spp.	--	2.2	--	2.0
Pinus clausa var. *immuginata*	.30	2.0	.30	1.8
Q. myrtifolia	--	1.4	--	1.3
Q. virginiana var. *geminata*	.03	1.3	.03	1.2
Licania michauxii	--	.7	--	.6
Q. laevis	--	.1	--	.1
Herbs (% cover)				
Rhychospora spp.		3.0		3.0
Galactia volubilis		2.0		2.0
Panic spp.		2.0		2.0
Lichens (% cover)				
Cladonia spp.		30.0		30.0

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Sand pine scrub, dominated by the Ocala variety, is native to the deep, dry, sandy deposits of central Florida. Choctawhatchee sand pine occurs on sandy sites along the coast of the Florida panhandle and adjoining counties in Alabama. Scrub consists of an overstory of sand pine and an understory of woody species dominated by oaks. Selected stands of old sand pine were sampled on the Ocala National Forest and near Niceville, FL, to determine the characteristics of old growth. Old-growth Ocala sand pine stands had an overstory of sand pine with some trees at least 14.0 inches (35.6 centimeters) in diameter and more than 55 years old. Canopy gaps were usually prevalent, often covering 25 percent or more of the area. Oaks, predominately sand live oaks, formed a conspicuous mid-story layer within these gaps. Old-growth Choctawhatchee sand pine stands were similar but generally had bigger and older trees than Ocala stands. Good examples of Ocala old growth exist on the Ocala National Forest. Stands of old-growth Choctawhatchee sand pine grow near Niceville, FL, on Eglin Air Force Base and nearby Fred Gannon State Park.

Keywords: Florida, oak, old growth, sand pine, scrub, understory.

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