Index of Species Information

**SPECIES: Pinus elliottii**

- Introductory
- Distribution and Occurrence
- Management Considerations
- Botanical and Ecological Characteristics
- Fire Ecology
- Fire Effects
- References

### Introductory

**SPECIES: Pinus elliottii**

**AUTHORSHIP AND CITATION:**

**ABBREVIATION:**
PINELL
PINELLE
PINELLD

**SYNONYMS:**
- Pinus densa (Little & Dorman) Gaussen
- Pinus caribaea Morelet (misapplied)
- Pinus heterophylla (Ell.) Sudworth

**SCS PLANT CODE:**
PIEL

**COMMON NAMES:**
- slash pine
- yellow slash pine
- swamp pine
- pitch pine
- South Florida slash pine
- Dade County slash pine
- Dade County pine
- Cuban pine

**TAXONOMY:**
The currently accepted scientific name of slash pine is Pinus elliottii Engelm. [23,24]. The species is divided into two geographic varieties:

- Pinus elliottii var. elliottii, typical variety
- Pinus elliottii var. densa Little & Dorman, South Florida slash pine

There is a transitional zone where morphological traits of the two varieties show clinal variation. Both varieties will be discussed in this report with emphasis on the typical slash pine variety, P. elliottii var. elliottii.

Slash pine occasionally hybridizes with loblolly pine (P. taeda), late flowering sand pine (P. clausa), and early flowering longleaf pine (P. palustris) [23,24].

**LIFE FORM:**
Tree

**FEDERAL LEGAL STATUS:**
No special status
OTHER STATUS:
NO-ENTRY

DISTRIBUTION AND OCCURRENCE

SPECIES: Pinus elliottii

GENERAL DISTRIBUTION:
The native range of the typical slash pine variety includes the Coastal
Plain from southern South Carolina to central Florida and west to
eastern Louisiana. Slash pine has been planted as far north as Kentucky
and Virginia [37], and as far west as eastern Texas, where it now
reproduces naturally [24]. South Florida slash pine occurs in central
and southern Florida and in the lower Florida Keys [2,24].

ECOSYSTEMS:
- FRES12 Longleaf - slash pine
- FRES13 Loblolly - shortleaf pine
- FRES14 Oak - pine
- FRES16 Oak - gum - cypress

STATES:
- AL
- AR
- FL
- GA
- KY
- LA
- MS
- NC
- OK
- SC
- TN
- TX
- VA

BLM PHYSIOGRAPHIC REGIONS:
NO-ENTRY

KUCHLER PLANT ASSOCIATIONS:
- K111 Oak - hickory - pine forest
- K112 Southern mixed forest
- K113 Southern floodplain forest
- K114 Pocosin
- K116 Subtropical pine forest

SAF COVER TYPES:
- 70 Longleaf pine
- 74 Cabbage palmetto
- 81 Loblolly pine
- 82 Loblolly pine - hardwood
- 83 Longleaf pine - slash pine
- 84 Slash pine
- 85 Slash pine - hardwood
- 97 Atlantic white cedar
- 98 Pond pine
- 100 Pond cypress
- 103 Water tupelo - swamp tupelo
- 104 Sweetbay - swamp tupelo - redbay
- 111 South Florida slash pine

SRM (RANGELAND) COVER TYPES:
NO-ENTRY

HABITAT TYPES AND PLANT COMMUNITIES:
The published classifications listing slash pine as dominant in
community types (cts) are presented below:

<table>
<thead>
<tr>
<th>Area</th>
<th>Classification</th>
<th>Authority</th>
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<tbody>
<tr>
<td>SC</td>
<td>general veg. cts</td>
<td>Nelson 1986</td>
</tr>
<tr>
<td>se US: Gulf Coast</td>
<td>general forest cts</td>
<td>Pessin 1933</td>
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<td>se US</td>
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<td>Waggoner 1975</td>
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<td>Christensen 1988</td>
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MANAGEMENT CONSIDERATIONS

SPECIES: Pinus elliottii

WOOD PRODUCTS VALUE:
Slash pine is an important timber species in the southeastern United
States. Its strong, heavy wood is excellent for construction purposes.
Because of its high resin content, the wood is also used for railroad
ties, poles, and piling [7,24,26,27].

http://www.fs.fed.us/database/feis/plants/tree/pinell/all.html
IMPORTANCE TO LIVESTOCK AND WILDLIFE:
Slash pine seeds are eaten by birds and small mammals. Cattle and deer occasionally browse seedlings [24]. In the St. Vincent National Wildlife Refuge of northwestern Florida, slash pine made up 0.7 percent of Indian sambar deer rumens and 0.6 percent of white-tailed deer rumens [34].

The dense foliage of slash pine provides cover and shelter for wildlife [24]. The endangered red-cockaded woodpecker is known to nest in slash pine, although it is not this cavity dweller's preferred species [15]. Large slash pine provide nest sites for bald eagles [48].

PALATABILITY:
NO-ENTRY

NUTRITIONAL VALUE:
NO-ENTRY

COVER VALUE:
NO-ENTRY

VALUE FOR REHABILITATION OF DISTURBED SITES:
Because of slash pine's rapid growth, it is used to stabilize soil and rehabilitate mine spoils. It grows well on coal mine spoils in northern Alabama [24,49].

OTHER USES AND VALUES:
Slash pine is the preferred naval stores species. Its resin is used for gum turpentine and rosin production [24,41].

OTHER MANAGEMENT CONSIDERATIONS:
Slash pine forest management requires integration of three primary uses: turpentine, wood, and forage production. Intense production and management for one use will likely reduce production for another use. For instance, turpentineing reduces slash pine growth by 25 percent while the tree is worked, a closed canopy reduces understory forage production, and fire used to improve forage production and quality may damage young trees [26].

Slash pine is best regenerated using even-aged management. Both the seed tree and shelterwood silviculture systems are effective. For adequate regeneration, leave 6 to 10 seed trees per acre and 25 to 40 shelterwood trees per acre. Overstory trees should be removed 1 to 3 years after seedlings are established. Seedbed preparation increases seedling establishment. Pine growth is enhanced by site preparation and removal of hardwood and saw palmetto (Serenoa repens) understory competition [22].

Cattle grazing is extensive on pine flatwoods in the Southeast. Pearson [31] reported that light to moderate grazing did not affect establishment, survival, or growth of seeded or planted slash pine up to 5 years old. Heavy grazing decreased survival, but most losses occurred in the first year. It is recommended that cattle be withheld from grazing young stands until after the first growing season [31].

Disease: The two most serious diseases of slash pine are fusiform rust (Cronartium quercuum f. sp. fusiforme) and annosus root rot (Heterobasidion annosum) [24,29]. Fusiform rust is a stem disease that affects seedlings and saplings. The younger the pine is when it becomes infected, the more likely it is to die [35]. Removing trees with severe stem galls minimizes timber losses and improves stand quality [3].

Annosus root rot infects thinned stands. The fungus colonizes on freshly cut stumps and spreads by root contact. Thick litter is associated with sporophore development [9]. Annosus root rot is most damaging to slash pine if there is good surface drainage. Slash pine grown on shallow soils with a heavy subsoil clay layer are not susceptible to annosus root rot [24].

Lophodermella cerina, a needle-blight-causing fungus, mainly affects slash pine close to metropolitan areas. Air pollution is thought to worsen this disease [38]. Pitch canker, caused by Fusarium moniliforme var. subglutinans, is common in plantations and can girdle a pine [24].

Insects: Insects that attack slash pine include pales weevil (Hylobius pales), black turpentine beetle (Bendroctonus terebrans), engraver beetles (Lps spp.), and defoliators such as pine web worm (Tetralopha robustella), blackheaded pine sawfly (Neodiprion excitans), redheaded pine sawfly (N. lecontei), and Texas leafcutting ant (Atta texana) [24].

South Florida slash pine is less susceptible to insects and disease than
the typical variety of slash pine. Grass-stage seedlings of South Florida slash pine are attacked by brown-spot needle blight (Scirrhia acicola) [24].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Pinus elliottii

GENERAL BOTANICAL CHARACTERISTICS:
Slash pine is a native evergreen conifer with thick plate bark and relatively long needles. It grows rapidly and lives approximately 200 years. Slash pine has an extensive lateral root system and a moderate taproot [24]. The typical slash pine variety has a straight bole and a narrow ovoid crown. Mature trees of this variety vary in height from 60 to 100 feet (18-30.5 m) and average 24 inches (61 cm) in d.b.h. [13].

The two varieties differ considerably in morphology. South Florida slash pine has longer needles, smaller cones, denser wood, and a thicker and longer taproot [24]. The trunk forks into large spreading branches which form a broad, rounded crown [13,46]. Mature trees attain only 56 feet (17 m) in height. The relatively short stature of South Florida slash pine probably evolved to avoid tropical storm damage [21].

RAUNKIAER LIFE FORM:
Phanerophyte

REGENERATION PROCESSES:
Seed production and dissemination: Slash pine is monoecious. Trees usually begin producing cones between 10 and 15 years of age. Good cone crops occur every 3 years for the typical variety and every 4 years for the South Florida variety. Ninety percent of the light, winged seeds fall within 150 feet (46 m) of the source tree [24].

Germination and seedling development: Germination is epigeal and occurs within 2 weeks of seedfall. Slash pine seeds have good viability. Exposed mineral soil enhances germination [24].

Open-grown seedlings of the typical slash pine variety grow 16 inches (41 cm) in the first year. Root development is best in clayey soil and worst in sandy soil [24].

Seedlings of the South Florida variety have a 2- to 6-year grass stage similar to that of longleaf pine. During the grass stage, seedlings develop an extensive root system and a thick root collar. Once initiated, height growth is rapid [13]. South Florida slash pine seedlings are more drought and flood tolerant than those of the typical variety [1,2].

Vegetative reproduction: South Florida slash pine grass-stage seedlings can sprout from the root collar if top-killed [24].

SITE CHARACTERISTICS:
Slash pine grows in a warm, humid climate and up to about 500 feet (150 m) in elevation. Slash pine grows best on mesic flatwood sites and on pond or stream margins where soil moisture is ample but not excessive, and drainage is poor [24]. Established stands grow well on flooded sites, but flooding restricts seedling establishment [14]. Soils include Spodosols, Ultisols, and Entisols. Slash pine’s native range was probably more restricted by frequent fire than by soil types or soil moisture. With fire suppression, slash pine has spread to drier sites [2,24].

The South Florida slash pine variety grows from near sea level to about 70 feet (20 m) in elevation [8]. This variety grows in a wide range of conditions, from wet sites in the northern part of its range to well-drained sandy soils and rocky limestone outcrops in the South [2,21].

Tree associates of slash pine include live oak (Quercus virginiana), water oak (Q. nigra), post oak (Q. stellata), blackjack oak (Q. marilandica), myrtle oak (Q. myrtifolia), bluejack oak (Q. incana), turkey oak (Q. laevis), southern red cedar (Juniperus silicicola), pond cypress (Taxodium ascendens), cabbage palmetto (Sabal palmetto), red maple (Acer rubrum), and sweetgum (Liquidambar styraciflua) [8].

Understory species on drier sites include pineland threeawn (Aristida stricta), bluestem (Andropogon spp.), saw-palmetto (Serenoa repens), gallberry (Ilex glabra), fetterbush (Lyonia lucida), and pitcher plant.
More than fifteen species of herbs are endemic to the Miami rock ridge pinelands where South Florida slash pine dominates [36].

**SUCCESSIONAL STATUS**:
Slash pine is relatively intolerant of competition and intolerant of shade [24]. It will reproduce in small openings and invade open longleaf pine stands, but growth is reduced by competition and partial shade [22]. Slash pine invades fallow agricultural fields and disturbed areas. It will invade longleaf pine stands where fire has been absent for at least 5 to 6 years. In the absence of fire, slash pine flatwoods are replaced by southern mixed hardwood forests on drier sites and by bayheads on wetter sites [49].

South Florida slash pine may be an edaphic or fire climax on flatwood sites [8]. In the absence of fire, this variety is also replaced by hardwoods. In pine rocklands, hardwood succession is rapid, but in pine flatwoods, vegetative changes occur more slowly [42].

**SEASONAL DEVELOPMENT**:
Male strobili begin to develop in June, grow for several weeks, and then go dormant until midwinter. Pollen is shed from late January to February. Female strobili begin to develop in late August and grow until they are fully developed. Cones mature in September, approximately 20 months after pollinization. Seed fall is in October [24].

**FIRE ECOLOGY**

**SPECIES: Pinus elliottii**

**FIRE ECOLOGY OR ADAPTATIONS**:
Young slash pine is susceptible to fire, but mature trees are fire resistant [4]. Thick bark and high, open crowns allow individuals to survive fire. Slash pine, however, is less fire resistant than longleaf or sand pine [27]. Seedlings grow fast, and in 10 to 12 years slash pine is resistant to fire that does not crown [46].

Estimates of the natural fire frequency of slash pine flatwoods range from 3 to 15 fires per century [8, 21]. A fire interval of at least 5 to 6 years allows young trees to develop some fire resistance. Fires are ignited by lightning in late spring and summer [10, 41]. Ample soil moisture and seasonally wet depressions and drainages of slash pine habitat impede fire entry. Occasional fire serves to reduce hardwood competition and expose mineral soil which enhances germination [21, 24].

The bark structure of slash pine is important to its fire resistance. Outer bark layers overlap and protect grooves where the bark is thinner [6]. The platy bark flakes off to dissipate heat [21].

The South Florida variety is more fire resistant than the typical variety because seedlings and saplings have thicker bark [1, 2, 24, 42]. The estimated natural fire frequency of South Florida slash pine communities is 25 fires per century [21]. Crown fires are rare because frequent fires reduce fuel build-up, trees self-prune well, and stands are open [1]. In addition to adaptations of the typical slash pine variety, the South Florida variety is fire resistant in the seedling grass stage. A dense tuft of needles protects the terminal bud. If top-killed by fire, the grass-stage seedling may sprout from the root collar [45]. See the longleaf pine review for further information on grass-stage seedlings.

**POSTFIRE REGENERATION STRATEGY**:
Crown-stored residual colonizer; short-viability seed in on-site cones off-site colonizer; seed carried by wind; postfire years one and two

**FIRE EFFECTS**

**SPECIES: Pinus elliottii**
IMMEDIATE FIRE EFFECT ON PLANT:

One- and two-year-old slash pine are killed by low-severity fire. After 3 to 4 years, seedlings survive low-severity fire but not moderate-severity fire. Ten- to fifteen-foot-tall (3.0-4.6 m) saplings survive moderate-severity fires. Once slash pine is 10 to 12 years old, it survives fire that does not crown [10,24,41,46].

Slash pine is tolerant of crown scorch. Scorched foliage is replaced by new shoots. Slash pine as young as 5 years old may recover from 100 percent crown scorch [6,41]. Slash pine taller than 5 feet (1.5 m) seldom die if less than 70 percent of the crown is scorched [26]. In New South Wales, Australia, a fall wildfire burned a slash pine plantation averaging 20 feet (6.1 m) in height. The fire crown'd in most areas. Trees with no green needles, few or no brown needles, and a drooping apical branch had 31 percent survival, trees with mostly brown needles and few or no green needles present had 93.8 percent survival, and trees with clearly visible green needles at the top had 96.9 percent survival [39].

Slash pine needles were killed instantly when immersed in water at 147 degrees Fahrenheit (64 deg C) but survived 9.5 minutes at 126 degrees Fahrenheit (52 deg C) [5].

If slash pine bark is thicker than 0.6 inch (1.5 cm), mortality due to cambium damage is unlikely from a low-severity fire. In one study, 0.08-inch (0.2 cm) thick bark protected the cambium from externally applied heat at a temperature of 572 degrees Fahrenheit (300 deg C) for 1 minute. Bark which was 0.47 inch (1.2 cm) thick protected the cambium from 1116 degrees Fahrenheit (600 deg C) for 2 minutes [6].

DISCUSSION AND QUALIFICATION OF FIRE EFFECT:

Seedlings of the South Florida variety are more fire resistant than the typical slash pine variety but less resistant than longleaf pine seedlings [46]. In Florida, 2-year-old seedlings of both varieties averaging 3 feet (0.9 m) in height were burned by wildfire in December. Twenty-three percent of the South Florida variety burned by headfire and 56 percent burned by backfire survived. Less than one percent of the typical variety survived either headfires or backfires. One-third of the South Florida slash pine survivors sprouted from dormant buds at or near the root collar and along the bole. Root collar sprouts died back after new needle growth appeared below the fire-killed leader [19].

A cool, prescribed winter fire in a South Florida slash pine stand killed many older pines, but young pines survived. Although there was no outward sign of fire damage, fire may have killed the feeder roots, and only young, vigorous pines were able to recover [43].

PLANT RESPONSE TO FIRE:

Slash pine's growth response to fire is variable. Slash pine damaged by fire may suffer a short-term reduction in growth, although fires that result in light or no scorch may actually enhance growth [41]. In the Georgia Coastal Plain, a 9-year-old stand averaging 24.5 feet (7.5 m) in height and 3.5 inches (8.9 cm) in d.b.h. was prescribed burned in February. In the first postfire growing season, slash pine with 0 to 15 percent crown scorch outgrew the control, pine with 15 to 40 percent crown scorch was not significantly different in growth from the control, and pine with more than 40 percent scorch showed reduced growth. Growth returned to normal in the second postfire growing season [16].

Severely scorched, 25-year-old slash pine in Georgia, averaging 8 inches (20 cm) in d.b.h., lost almost a full year's growth in two growing seasons. Growth of trees with less than 10 percent crown scorch was only 85 percent of unburned trees after 2 years [17]. In Louisiana, annual and biennial prescribed backfires initiated in a 4-year-old stand averaging 7.8 feet (2.4 m) in height reduced growth, but triennial fires did not. Whether the fires were in May or March had no effect on growth [12].

Height growth is slightly more sensitive to needle scorch than diameter growth. McCulley [26] reported that height growth loss occurred in trees with no scorch if they were smaller than 7 inches (18 cm) in d.b.h., but diameter growth loss only occurred in trees with greater than 30 percent crown scorch.

DISCUSSION AND QUALIFICATION OF PLANT RESPONSE:

NO-ENTRY

FIRE MANAGEMENT CONSIDERATIONS:

If a poor seed crop is expected, prescribed burning should be done prior to seedfall to enhance germination. Prescribed burning before stand establishment also reduces fire hazard in young stands. Prescribed
burning at 3 to 5 year intervals throughout the stand rotation will facilitate future seedbed preparation, and control but not eradicate hardwoods. Hardwoods benefit wildlife and complete eradication is not necessary. At the end of the rotation, successive summer fires can be used for site preparation [22]. In the southern Florida pine rocklands, fire every 3 to 7 years has effectively controlled hardwoods [42].

Young slash pine stands should not be burned for the first 5 years or until the stand is 12 to 15 feet (3.7-4.6 m) tall [22,26,46]. Cattle can be used to reduce fuel buildup until young pine stands are resistant to light fire [13,46].

Prescribed winter and spring burning is usually done in pine flatwoods every 2 to 3 years to increase range grasses for cattle [41].

In the Coastal Plain, prescribed burning before and after thinning reduced infection by root rot caused by Heterobasidion annosum. The fire destroyed the litter that is associated with sporophore development of the fungus. A fungal competitor, Trichoderma spp., increased in the soil after burning and may have contributed to the reduced infection [8].

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SPECIES: Pinus elliottii

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