Blue Springs Tract of Twin Rivers State Forest (Hamilton County) Photo by Carolyn Kindell

Upland Pine

Description: Upland pine is a woodland of widely spaced pines with a sparse to moderate shrub layer and a dense, species-rich groundcover of grasses and herbs, occurring on gently rolling terrain. The canopy is dominated by longleaf pine (*Pinus palustris*); shortleaf pine (*P. echinata*) also may be present. There is an intermittent subcanopy layer of smaller pines, and hardwoods including southern red oak (*Quercus falcata*), blackjack oak (*Q. marilandica*), flowering dogwood (*Cornus florida*), bluejack oak (*Q. incana*), post oak (*Q. stellata*), sassafras (*Sassafras albidum*), laurel oak (*Q. hemisphaerica*), winged sumac (*Rhus copallinum*), common persimmon (*Diospyros virginiana*), sand post oak (*Q. margaretta*), mockernut hickory (*Carya alba*), and sourgum (*Nyssa sylvatica*). Though typically present as low shrubs and occasional midstory trees, these species can form a dense midstory (subcanopy and tall shrubs layers) in areas that have experienced a lack of fire for many years. Shrub cover can vary from sparse to dense, and includes low-growing species such as dwarf huckleberry (*Gaylussacia dumosa*), running oak (*Q. elliottii*), gallberry (*Ilex glabra*), and Darrow's blueberry (*Vaccinium darrowii*). Herbaceous cover varies, from sparse to abundant, dependent upon the density and shading effects of the shrubs. Wiregrass (*Aristida stricta* var. *beyrichiana*) is often dominant, but a high diversity of grasses and forbs may be present; as many as 40-50 species m^{-2} (Kirkman et al. 2001). In addition to wiregrass, other common grasses are little bluestem (*Schizachyrium scoparium*), broomsedge bluestem (*Andropogon virginicus*), hairawn muhly (*Muhlenbergia capillaris*), and

indiangrass (*Sorghastrum* spp.). Typical forbs include oblongleaf twinflower (*Dyschoriste oblongifolia*), narrowleaf silkgrass (*Pityopsis graminifolia*), pineland silkgrass (*Pityopsis aspera*), scaleleaf aster (*Symphyotrichum adnatum*), bracken fern (*Pteridium aquilinum*), goldenrod (*Solidago* spp.), squarehead (*Tetragonotheca helianthoides*), soft greeneyes (*Berlandiera pumila*), yellow jessamine (*Gelsemium sempervirens*), rice button aster (*Symphyotrichum dumosum*), and often a diverse suite of legumes including sensitive pea (*Chamaecrista nictitans*), sensitive briar (*Mimosa quadrivalvis*), sidebeak pencil flower (*Stylosanthes biflora*), and goat's rue (*Tephrosia virginiana*). Woody vines such as greenbrier (*Smilax* spp.) and summer grape (*Vitis aestivalis*) are occasionally present.

Upland pine primarily occurs on the rolling hills of northern Florida north of the Cody Scarp where the soils, classed as ultisols, are composed of sandy loams and loamy sands with clayey subsoils of Miocene and Pleistocene origin (Myers 1990). The presence of clay helps retain soil moisture, creating more mesic conditions than are found on the deep sands that support sandhill. Thus, some plant species (e.g., gallberry, Darrow's blueberry) are found in upland pine that, on more sandy soils, are restricted to lowlands such as mesic flatwoods. Upland pine also occurs in a few locations south of the Cody Scarp in the Florida Panhandle, and in the northern peninsula on soils that are influenced by clays, or where limestone is near the surface (e.g., calcitic and phosphatic influenced clayey soils, Citronelle influenced soils; Myers 1990).

Characteristic Set of Species: longleaf pine, wiregrass, southern red oak, flowering dogwood, sassafras, and the presence of a high diversity of legume species

Rare Species: Rare plant species in upland pine include chaffseed (*Schwalbea americana*), Barbara's buttons (*Marshallia obovata*), and hairy wild indigo (*Baptisia calycosa* var. *villosa*; only in the western Panhandle). Rare animals include tiger salamander (*Ambystoma tigrinum*), gopher tortoise (*Gopherus polyphemus*), timber rattlesnake (*Crotalus horridus*), red-cockaded woodpecker (*Picoides borealis*), Bachman's sparrow (*Aimophila aestivalis*), hairy woodpecker (*Picoides villosus*), Sherman's fox squirrel (*Sciurus niger shermani*), southern fox squirrel (*S. n. niger*), and eastern chipmunk (*Tamias striatus*). At least one rare invertebrate species, Cartwright's mycotrupes beetle (*Mycotrupes cartwrighti*), appears to be restricted to upland pine and upland mixed woodland in the northern Florida Panhandle above the Cody Scarp (Almquist, pers. comm. 2007).

Range: Upland pine occurs in northern Florida, southern Alabama, and Georgia. In Florida it is primarily in the northern Panhandle in the clay-rich soils north of the Cody scarp (Myers 1990) from the western Florida boundary to at least Hamilton County. Outside of this geographic range it occurs in areas where upland edaphic conditions are influenced by clays (Alachua and Marion counties) or where limestone is near the surface (e.g., Wakulla Springs State Park in Wakulla County).

Upland pine is part of an extensive mosaic of longleaf pine-associated natural communities that historically dominated the southeastern U.S. coastal plain. In Florida, this longleaf pine mosaic also included sandhills, mesic flatwoods, and wet flatwoods communities. This ecosystem has experienced a 98 percent decline in acreage throughout its range and is considered globally critically endangered (Noss et al. 1995;

Stein et al. 2000). From 1936 to 1995, Florida experienced a 90 percent decline in longleaf pinelands due to conversion to pine plantations, development, and agriculture (Kautz 1998).

Natural Processes: Fire is the dominant factor in the ecology of upland pine. Frequent low-intensity ground fires during the growing season reduce hardwood competition and facilitate pine and wiregrass reproduction (Myers 1990). The abundance of woody understory species increases with increasing time between fires. The historic fire frequency ranged from one to three years (Frost 1998). Without relatively frequent fires water oak (*Q. nigra*), live oak (*Q. virginiana*), sweetgum (*Liquidambar styraciflua*), common persimmon, laurel oak, and other fire-sensitive, fast growing trees invade and shade the otherwise diverse ground layer.

Community Variations: Vast differences in vegetation composition exist between natural upland pine and pinelands that have a history of land clearing, agriculture, or heavy disturbance (often referred to as "old-field pinelands"). In the latter, longleaf pine is often replaced by loblolly pine (*Pinus taeda*) or shortleaf pine, and the wiregrass-dominated groundcover is replaced with old-field species (Ostertag and Robertson 2006) such as broomsedges (*Andropogon* spp.), dogfennel (*Eupatorium capillifolium*), and blackberries (*Rubus* spp.). Ostertag and Robertson (2006) identified 17 species of herbs that could be used as indicators of natural upland pine. A similar suite of herbaceous species was found to be sensitive to disturbance and have low re-colonization rates in a disturbed upland pine in southwest Georgia (Kirkman et al. 2004). Absence of wiregrass is the clearest indicator that an upland pine has a disturbance history (Ostertag and Robertson 2006). These studies both listed goat's rue, oblongleaf twinflower, hairawn muhly, bracken fern, and rice button aster, among others, as indicators of natural upland pine. Additionally, land-use history plays an important role in the effect fire has on community structure; natural pinelands have higher fine fuels and generally higher fire intensity, thus having a greater effect on reduction of cover of woody species than do old-field pinelands with a history of agriculture (Ostertag and Robertson 2006).

Associated Communities: Upland pine is associated with and often grades into upland mixed woodland, upland hardwood forest, or sandhill. It differs from upland mixed woodland and upland hardwood forest in being dominated by an open canopy of pines and having a dense herbaceous ground layer, often dominated by wiregrass. Upland hardwood forests have a dense hardwood canopy of mesophytic species such as American beech (*Fagus grandifolia*), southern magnolia (*Magnolia grandiflora*), spruce pine (*P. glabra*), and American holly (*Ilex opaca*) and lack longleaf pine. Upland mixed woodland is dominated by a partially closed canopy of pines, large oaks (e.g., southern red oak, post oak, and blackjack oak) and mockernut hickory and sparse, if any, wiregrass. Upland mixed woodland can develop in the ecotone between upland pine and upland hardwood forests (Clewell 1986). Also, isolated pockets of this more oak-dominated community can also occur within large expanses of upland pine. Upland pine is often confused with sandhill. Sandhill can occur on small sandy rises or caps within upland pine. While these two community types have a large overlap in species, some species of plants such as flowering dogwood, sassafras, and southern red oak more commonly occur in upland pine, while turkey oak, pricklypear (*Opuntia humifusa*), and dogtongue wild buckwheat (*Eriogonum tomentosum*) more commonly occurs in sandhill.

Another primary difference between them resides in their soil characteristics (upland pine mostly occurs on sandy loam or loamy sand soils, whereas sandhill occurs on deep sands). Upland pine can be distinguished from mesic flatwoods by its occurrence on rolling hills rather than flatlands and by its lack of saw palmetto (*Serenoa repens*).

Management Considerations: Frequent (1-3 year interval) fires are essential for the maintenance of the upland pine community. Frequent fires reduce ground litter and prevent hardwood and shrub encroachment into the midstory. These effects are essential for the regeneration and maintenance of longleaf pines, as well as the highly diverse herbaceous groundcover that characterizes upland pine communities. Variability in the season, frequency, and intensity of fire may also be important for preserving species diversity, since different species in the community flourish under different fire regimes (Myers 1990; Robbins and Myers 1992).

In order to maintain or restore natural historic conditions, prescribed fire should be applied in upland pine on a 1-3 year interval, primarily in the warm season (April – June). Longer fire intervals can lead to a build-up of fuel loads. When fuel loads are increased by an additional 2-3 years of accumulation, studies of fire physics show an exponential gain in heat-release rates which can be lethal to longleaf pine (Rothermel 1983; Thompson, pers. comm. 2006). After long periods without fire, the burning of accumulated duff during very dry conditions can burn live roots growing in the duff and cause pine mortality (Varner et al. 2005). Where older, larger trees are rare due to past disturbances, reducing dense vegetation and removing duff around the tree bases is one option for protecting these pines in long unburned sites. Lighting multiple low-intensity fires over a period of years, when the duff is relatively moist is another effective means for gradually reducing accumulations of duff and heavier fuels.

In areas where fire exclusion has resulted in heavy hardwood and shrub encroachment, reduction of the midstory by a combination of fire and mechanical or chemical treatments, may be appropriate (Welch et al. 2004). However, widespread soil disturbance in longleaf pine-wiregrass communities should be avoided. Soil disturbance encourages the establishment of weedy species and diminishes existing native groundcover, especially wiregrass (Lewis 1970; Buckner and Landers 1979; Provencher et al. 2001). Provencher et al. (1999) found that prescribed fire in the growing season was the most cost effective method of hardwood midstory removal in sandhills when compared to chainsaw felling and fire, or herbicide treatment and fire. The use of herbicides, while more expensive, had the greatest effect on hardwood mortality when followed with prescribed fire (Provencher et al. 1999; Welch et al. 2004). However, herbicide treatment had negative effects on several non-target species and reduced the overall richness of groundcover species. Provencher (2001) also noted that, while chainsaw felling of midstory oaks reduced woody species density, it was no more effective at increasing groundcover diversity than prescribed fire alone.

Where the original native groundcover has been eliminated or severely altered, restoration to its original condition may not be possible or practical. Many species in the groundcover are unlikely to recover naturally once they are lost (Clewell 1986; Myers 1990; Cox et al. 2004) due to the dispersal limitations of many of the dominant herbaceous components (Kirkman et al. 2004). It is labor intensive and sometimes very

difficult to propagate and reestablish wiregrass where it has been extirpated (Myers 1990; Cox et al. 2004). Wiregrass is only one of dozens of groundcover species that are characteristic in natural upland pine systems, making re-establishment of the original plant species diversity, if possible, challenging.

Invasive exotic plant species can be a problem in upland pine through competition for light and nutrients. Cogon grass (*Imperata cylindrica*), mimosa (*Albizia julibrissin*), Japanese climbing fern (*Lygodium japonicum*), Japanese honeysuckle (*Lonicera japonica*), and natal grass (*Melinis repens*) are especially problematic invaders of upland pine.

Exemplary Sites: Blue Springs Tract of the Twin Rivers State Forest (Hamilton County), Blackwater River State Forest (Okaloosa, Escambia, and Santa Rosa counties), Apalachee Wildlife Management Area (Jackson County)

Global and State Rank: G3/S2

Crosswalk and Synonyms:

Kuchler	112/Southern Mixed Forest
Davis	4/Mixed Hardwoods and Pines
SCS	5/Mixed Hardwood and Pine
Myers and Ewel	High pine - clayhill
SAF	70/Longleaf Pine
	75/Shortleaf Pine
	76/Shortleaf Pine - Oak
	80/Loblolly Pine - Shortleaf Pine
	81/Loblolly Pine
	82/Loblolly Pine - Hardwood
FLUCCS	414/Pine - Mesic Oak
	423/Oak - Pine - Hickory

Other synonyms: longleaf pine upland forest (Wharton 1978); longleaf pine savannah (Clewell 1986); southern mesic longleaf woodland (Peet and Allard 1993); longleaf pine upland forest (Wharton 1978)

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Apalachee Wildlife Management Area (Jackson County) Photo by Amy Jenkins