Lake June-in-Winter State Park (Highlands County) Photo by Dan Hipes

Scrub

Description: Scrub is a community composed of evergreen shrubs, with or without a canopy of pines, and is found on dry, infertile, sandy ridges. The signature scrub species – three species of shrubby oaks, Florida rosemary (*Ceratiola ericoides*), and sand pine (*Pinus clausa*) – are common to scrubs throughout the state. The dominance of these species, however, is variable from site to site. The most common form is oak scrub, dominated by three species of shrubby oaks – myrtle oak (*Quercus myrtifolia*), sand live oak (*Q. geminata*), and Chapman's oak (*Q. chapmanii*) -- plus rusty staggerbush (*Lyonia ferruginea*) and saw palmetto (*Serenoa repens*). Florida rosemary and sand pine may also be present. On the Lake Wales Ridge in Central Florida, myrtle oak may be replaced by a close relative, scrub oak (*Q. inopina*), especially in unshaded, lower elevation oak scrubs that grade into mesic flatwoods (Johnson and Abrahamson 1982). Fetterbush (*Lyonia lucida*) and saw palmetto are also more frequent in these lower elevation scrubs, both on the Lake Wales Ridge and at Merritt Island NWR (Schmalzer 2003). The oaks form a dense cover interspersed with patchy openings that consist of bare sand with a sparse cover of herbs, particularly threeawns (*Aristida* spp.), hairsedges (*Bulbostylis* spp.), and sandyfield beaksedge (*Rhynchospora megalocarpa*), as well as subshrubs such as pinweeds (*Lechea* spp.) and jointweeds (*Polygonella* spp.), and ground lichens (*Cladonia leporina*, *C. prostrata*, *Cladina subtenuis*, and *C. evansii*).

Some scrubs are dominated by Florida rosemary, especially on drier ridge crests. This needle-leaved evergreen shrub is also the main colonizer of recently stabilized dunes on

Florida Panhandle barrier islands (Johnson 1997). Rosemary-dominated scrubs tend to retain openings between the shrubs, even long after fire, in contrast to oak-dominated scrubs where vegetation tends to fill in openings with time since fire (Hawkes and Menges 1996; Young and Menges 1999). Several rare herbs at the southern end of the Lake Wales Ridge that favor these sandy openings are more frequent in rosemary than in oak-dominated scrubs (Menges 2007).

Scrubs dominated by a canopy of sand pine are usually found on the highest sandy ridgelines. The pine canopy may range from widely scattered trees with a short, spreading growth form, to tall thin trees forming a dense canopy of uniform height. The sand pine scrub understory is characterized by either scrub oaks or Florida rosemary.

Scrubs occur on either white (St. Lucie, Archbold), or yellow (Astatula, Paola) low-nutrient, acid sands with little organic matter. Scrub is located on dry, infertile, sandy ridges which often mark the location of former Plio-Pleistocene shorelines (Laessle 1958; Myers 1990; Webb 1990).

Characteristic Set of Species: myrtle oak, Chapman's oak, sand live oak, scrub oak sand pine, Florida rosemary

Rare Species: Scrub harbors a wealth of species endemic to Florida, many of which are considered rare. Scrubs on the Lake Wales Ridge support 27 rare plant species, 14 of which are shared with scrubs on other peninsular ridges (Turner et al. 2006). An additional ten species are found on near-coastal ridges or inland peninsular ridges other than the Lake Wales Ridge (Table 1). Many species have very narrow ranges, occurring on only a small portion of their respective ridges.

Peninsular scrubs are home to four rare vertebrate animals, including the widely distributed Florida scrub-jay (*Aphelocoma coerulescens*) and scrub lizard (*Sceloporus woodi*), the more narrowly distributed sand skink (*Neoseps reynoldsi*), found only on the Lake Wales Ridge, and blue-tailed mole skink (*Eumeces egregious lividus*), found on the Lake Wales Ridge and in Ocala National Forest. Additional species endemic to scrub and other xeric habitats in Florida include the Florida mouse (*Podomys floridanus*) and the short-tailed snake (*Stilosoma extenuatum*). Scrub is also important for gopher tortoise (*Gopherus polyphemus*) and its associated commensals. Roughly 56 arthropods from a wide variety of taxonomic groups are endemic to peninsular scrubs; examples of these include the red widow spider, five wolf spiders, one cockroach, three grasshoppers, two tiger beetles, 12 scarab beetles, two fireflies, one moth, three velvet ants, and three ants (Deyrup 1989; Deyrup, pers. comm. 2007).

Range: Scrub is centered in Florida but extends westward on barrier islands to Alabama and Mississippi and small patches are found northward into southeastern Georgia (Wharton 1978). In Florida, scrub tends to be distributed in long, narrow, ridges parallel to coastlines and is scarce or absent from the limestone-dominated southernmost portion of the state.

The largest continuous area of scrub is in the Ocala National Forest (ca. 200,000 acres) in Marion County, with another concentration to the southeast in Lake and Seminole counties. Other relatively large areas of scrub occur on the Lake Wales Ridge, the

Atlantic Coastal Ridge, and along the Panhandle coast, including barrier islands. Scrub can also be found in small patches on xeric ridges and soils scattered across the central Florida peninsula. Scrub is rare on barrier islands of the peninsula (Johnson and Muller 1993).

Natural Processes: While scrub is a fire-maintained community, it is not easily ignited. Scrub is thought to have burned less frequently than communities with a more easily ignited grassy groundcover, such as sandhill and mesic flatwoods. With direct evidence for the natural range of fire return intervals in scrub largely lacking, upper and lower limits have been inferred from life history traits of the dominant plants or from the requirements of animal species dependent on scrub (Menges and Kohfeldt 1995; Main and Menges 1997; Menges 2007).

Scrub oak-dominated oak scrub on the Lake Wales Ridge likely burned naturally at intervals within 5 and 20 years (Main and Menges 1997) based on the habitat requirements of the Florida scrub-jay. Oak height is a critical limiting factor for Florida scrub-jays which have been documented to begin to abandon territories where the oaks reached this height on the Lake Wales Ridge (Fitzpatrick et al. 1991) and to suffer a net population loss in territories on Merritt Island on the Atlantic coast where patches of oak scrub in their territories were either taller than 1.7 meters or shorter than 1.2 meters (Breininger and Carter 2003). The lower limit of 5 years is based on the time required for re-sprouting oak stems to reach acorn-bearing height (Ostertag and Menges 1994), acorns being an important part of the scrub jay's diet.

Rosemary scrub likely burned at intervals within 10 and 40 years, based on the life history characteristics of Florida rosemary, a species that is killed by fire and must re-establish from seed. The lower limit is set by the age at which rosemary first begins to produce seed and the upper limit by the age at which the shrub begins to die back and seed production declines (Johnson 1982). Whereas most inland rosemary stands are even-aged and show little or no seedling recruitment between fires, those on the outermost coastal dunes in the Panhandle are uneven-aged and apparently do not require fire for regeneration (Gibson and Menges 1994).

Sand pine scrub in the peninsula may have naturally burned at intervals of more than 10 years based on the life history of the sand pine. The trees are usually killed by fire and must re-establish from seed. Although trees as young as five years may begin producing cones (Lowery, pers. comm. 2007), it probably takes somewhat longer to produce a crop of seeds large enough to replace a stand. Experience in Ocala National Forest has shown that two burns within a 10 year period will prevent or reduce sand pine regeneration (Cooper 1973). Since the variety of sand pine that grows in the peninsula (*P. clausa* var. *clausa*, also known as the Ocala variety) tends to bear closed cones that open only after a fire, the extreme upper limit of fire return interval would be determined by the longevity of these trees which is about 80 years. In the absence of fire, the pines would die off and the understory scrub oaks would grow up to tree height to form a xeric hammock. However, fires from surrounding communities probably burned into sand pine scrub more frequently than every 80 years, especially during drought periods, which tend to recur periodically at roughly 20 year intervals following the El Nino Southern Oscillation climate cycle (Verdi et al. 2006). Thus sand pine scrub was probably a mosaic of patches

of different ages since the last burn, as is shown on the plat maps and surveyors' notes for Ocala National Forest produced by the General Land Office surveys in the mid-1800's where "scrub" alternates with "spruce pine scrub" and dead pines killed by fire were often noted. Such a mosaic would have provided the open, unshaded areas required by many of the rare plant and animal species that occur in scrub.

The variety of sand pine in Panhandle scrubs (*P. clausa* var. *immuginata*, or the Choctawhatchee variety) is open-coned and is therefore capable of maintaining its populations in the absence of fire (Parker et al. 2001). Sand pines are highly susceptible to being killed by salt spray and wind throw from coastal storms. Storm-related disturbances in sand pine scrub along the Panhandle coast play a significant role in stimulating stand regeneration in this region (Huck et al. 1996).

Scrub occurs on deep nutrient-poor sands. More nutrients are concentrated in the plant biomass of scrubs than in the soils (Schmalzer and Hinkle 1987). A potentially significant nutrient source is nitrogen-fixing cyanobacteria found in soil crusts in rosemary scrubs. Density of cyanobacteria increases from zero immediately post-fire to a peak 8-15 years post-fire and declines thereafter (Hawkes and Flechtner 2002).

Community Variations: Whereas the signature scrub species (myrtle oak, sand live oak, and Chapman's oak) are common to scrubs throughout the state, some variation in species composition exists between Panhandle and peninsular scrubs. Common species found only in Panhandle scrubs are woody goldenrod (*Chrysoma pauciflosculosa*) and false rosemary (*Conradina canescens* sensu Shinners [1962]). Species that distinguish peninsular from Panhandle scrubs include scrub hickory (*Carya floridana*), garberia (*Garberia heterophylla*), scrub holly (*Ilex opaca* var. *arenicola*), scrub wild olive (*Osmanthus megacarpus*), Feay's palafox (*Palafoxia feayi*), silk bay (*Persea borbonia* var. *humilis*), scrub palmetto (*Sabal etonia*), and hog plum (*Ximenia americana*).

Harper (1927) noted that scrub on the southern Lake Wales Ridge tended to be more open and often lacked the sand pine canopy common in scrubs further north. This is the same area where oak scrubs are dominated by scrub oak rather than myrtle oak. Stems of the former have been shown to live only four or five years on average, indicative of a situation where it is not likely to be shaded out by competing species (Johnson and Abrahamson 2002).

Some areas of oak scrub on the southern end of Lake Wales Ridge are known locally as "yellow sand scrub" and are characterized by scrub hickory and myrtle oak and the absence of scrub oak. Yellow sand scrubs are further distinguished by a suite of rare Florida endemic species, e.g., scrub buckwheat (*Eriogonum longifolium* var. *gnaphalifolium*), Garrett's scrub balm (*Dicerandra christmanii*), different from that found in white sand scrubs (Menges et al. 2007) and have higher levels of nitrogen and phosphorus than white sand rosemary scrubs (Carrington and Keeley 1999).

Variants: OAK SCRUB – Scrub dominated by three shrubby oaks, myrtle oak, sand live oak, and Chapman's oak, with scrub oak substituting for myrtle oak at the southern end of the Lake Wales Ridge. Found on dry sandy ridges throughout the state. Suggested fire return intervals within a range of 3-20 years depending on type.

ROSEMARY SCRUB – Scrub dominated by Florida rosemary (commonly referred to as "rosemary balds"), usually with large areas of bare sand visible between the shrubs. Found on the driest ridge crests, particularly at the southern end of the Lake Wales Ridge and Panhandle barrier islands. Suggested fire return intervals between 15 and 30 years.

SAND PINE SCRUB – Scrub with a canopy of sand pine and an understory of the three shrubby oaks, or less commonly, Florida rosemary. Found throughout the state but less commonly on the southern end of the Lake Wales Ridge. Suggested variable fire return intervals (between 5 and 40 years) in peninsula to maintain mosaic of different ages; possibly longer intervals in Panhandle due to added disturbance of coastal storms.

Associated Communities: Scrub may be associated with, and grade into, mesic flatwoods, scrubby flatwoods, xeric hammock, sandhill, coastal strand, and maritime hammock. Scrub differs from mesic flatwoods in having little to no cover of slash or longleaf pines, wiregrass (*Aristida stricta*), or such flatwoods shrubs as gallberry (*Ilex glabra*). It differs from scrubby flatwoods in the lack of, or low cover of, the aforementioned species and in having a nearly continuous cover, as opposed to a patchy cover, of scrub oaks (myrtle oak, Chapman's oak, and sand live oak). Scrub is distinguished from xeric hammock by the absence of a closed oak canopy. It differs from sandhill in having little to no cover of wiregrass or deciduous oaks, such as turkey oak (*Quercus laevis*), bluejack oak (*Q. incana*), and sand post oak (*Q. margaretta*), and by lacking a longleaf pine canopy. Scrub differs from coastal strand and maritime hammock in being dominated by myrtle oak and sand live oak and not by live oak (*Quercus virginiana*), cabbage palm (*Sabal palmetto*), buckthorn (*Sideroxylon tenax*), or red bay (*Persea borbonia*), or by tropical species such as Simpson's stopper (*Myrcianthes fragrans*) and seagrape (*Coccoloba uvifera*). Scrub also occurs on acidic rather than calcareous sands. Shrub height in the coastal strand community is controlled by salt spray pruning, rather than the combination of frequent fire and nutrient-deficient soils that characterize scrubs.

Management Considerations: There has been a concerted effort to preserve scrub through land acquisition at the local, state, and federal levels beginning in the late 1980s. At that time, range-wide surveys indicated Florida scrub-jay populations were in decline and rare plant species (including a number of newly described species) were not uniformly distributed in scrubs (Christman and Judd 1990). Many scrubs have been preserved through the state land acquisition program which identified projects containing scrub on the Lake Wales Ridge, the Atlantic Coastal Ridge and the Panhandle coast (FDEP 2004). The United States Fish and Wildlife Service, as well as Brevard, Hillsborough, and Palm Beach Counties also purchased important scrub areas. These efforts are ongoing. On the Lake Wales Ridge, for example, 21,500 acres of scrub and sandhill were acquired within the last two decades, with nearly as many acres identified as needing to be preserved (Turner et al. 2006).

Much of the scrub recently brought under protection is long unburned, raising the issue of how to manage it. Recommended intervals for prescribed fire in scrub cover a narrower range than the natural limits at which populations of dominant species or scrub-dependent plants and animals begin to decline. Oak scrub is thought to have a range of natural fire return intervals considerably shorter than that of sand pine or rosemary scrub. For *Quercus inopina*-dominated oak scrub, fire return intervals between 8 and 15 years are recommended as optimal for maintaining scrub-jay populations (Woolfenden and Fitzpatrick 1992). Shorter intervals of 5-12 years have been suggested for the faster-growing yellow sand scrub on the Lake Wales Ridge based on a population viability model for the rare endemic scrub mint (*Dicerandra frutescens*; Menges 2007). In myrtle oak-dominated scrubs on Merritt Island on the Atlantic coast, Breininger et al. (2002) suggest natural fire return limits of between 3 and 20 years. They found that scrub-jay territories with patches of scrub burned at intervals between 10-20 years, which would be 1.2-1.7 meters tall (Schmalzer 2003), surrounded by more frequently burned shorter scrub to be optimal for sustaining scrub-jay populations. Growth rates of scrub oaks are related to burn history and environmental conditions of the site. Long unburned oak scrub may attain heights unsuitable for scrub-jays up to 50 percent faster after fire than regularly burned oak scrub and thus may at first require shorter burn intervals to maintain optimum heights following restoration of burning (Schmalzer and Adrian 2001). In addition, small openings, needed by Florida scrub jays for caching acorns, may need to be artificially restored in long unburned scrubs by piling up fuel to create hotspots that kill the roots of the oaks (Schmalzer and Adrian 2001).

For rosemary scrub, fire return intervals of 15-30 years, allowing patchy burns to provide refuges for older rosemary plants, have been recommended based on population viability models for wedge-leaved button-snakeroot (*Eryngium cuneifolium*) and other rare endemics found in this community (Menges 2007).

Less is known about the effects of different fire return intervals in sand pine scrub due to lack of prescribed fires in this community, so a variable fire return interval is usually recommended to maintain patches of different ages. Crown fires in sand pine scrub can burn very hot and fast due to the close spacing, uniform height, and resinous needles of sand pines. A 1935 wildfire in Ocala National Forest burned 35,000 acres in four hours (Sekerak and Hinchee 2001). Although prescribed burns have been successfully conducted in sand pine scrub (Greenberg 2003), other methods have utilized mechanical felling of pines followed by burning which avoids crown fires, while mimicking the natural system in terms of releasing pine seeds, burning off understory oaks, and returning nutrients to the system in the form of ash (Doren et al. 1987). The lowered height of the sand pine scrub canopy following fire opens a time window for Florida scrub-jays to colonize an area until the sand pines again reach a height that excludes them. Oak scrub that has become too tall to burn under prescribed conditions may also be chopped and burned. By returning the community first to a desired height, the scrub can then be burned under prescribed conditions and within the normal return interval (Schmalzer and Adrian 2001).

Some scrub species increase (e.g. ground lichens) while others decrease (e.g. wedge-leaved button-snakeroot and other rare herbs) with time between fires. In order to preserve diversity it is important to burn at variable, rather than regular, intervals within

the normal limits of fire return intervals for a given type of scrub (Menges and Kohfeldt 1995) and to maintain spatial variety in fire frequency within scrubs by allowing more frequent fires set in mesic flatwoods to burn into embedded scrubs and naturally extinguish (Breininger et al. 2002).

Reference Sites: Topsail Hill State Park (Walton County), Ocala National Forest (Marion County), Lake June-in-Winter State Park and Archbold Biological Station (Highlands County), Merritt Island National Wildlife Refuge (Brevard County), Jonathan Dickinson State Park and Juno Dunes Natural Area (Martin County), Balm Boyette Scrub (Hillsborough County), Starkey Wilderness Park (Pasco County), St. Joseph Peninsula State Park (Gulf County), Lake Wales Ridge Wildlife and Environmental Area (Highlands and Polk Counties), Saddle Blanket Lakes Preserve (Polk County), Three Lakes Wildlife Management Area (Osceola County), Cedar Key Scrub State Preserve (Levy County)

Global and State Rank: G2/S2

Crosswalk and Synonyms:

Kuchler	115/sand pine scrub
Davis	5/sand pine scrub
SCS	3/sand pine scrub
Myers and Ewel	Scrub – sand pine, oak, and rosemary scrub; slash pine scrub
SAF	69/sand pine
FLUUCS	413/sand pine
Whitney	interior scrub

Other synonyms: oak-palmetto scrub (Breininger and Schmalzer 1990); scrubby flatwoods sensu Laessle (1958) and Abrahamson et al. (1984)

Table 1. Ranges of rare plant species in Florida scrubs (county abbreviations are listed for species with restricted ranges; Turner et al. 2006).

Lake Wales Ridge only-13 species	**Lake Wales Ridge plus other peninsular ridges-14 species**	**Coastal ridges only– 7 species**	**Other inland peninsular ridges only – 3 species**
Chrysopsis highlandsensis-HIGH	*Bonamia grandiflora*	**East coast:**	*Conradina etonia* – PUTN
Crotalaria avonensis -- POLK/HIGH	*Calamintha ashei*	*Asimina tetramera* – MART/PALM	*Dicerandra cornutissima* - MARI
Dicerandra christmanii - HIGH	*Centrosema arenicola*	*Conradina grandiflora*	*Lupinus westianus* var. *aridorum* – ORAN/POLK
Dicerandra frutescens	*Chionanthus pygmaeus*	*Dicerandra immaculata* – MART/PALM/STLU	**Panhandle coast and inland peninsular ridges-1 species**
Eryngium cuneifolium-HIGH	*Clitoria fragrans*	*Dicerandra thinicola* - BREV	*Cladonia perforata*
Euphorbia rosescens	*Conradina brevifolia (sensu* Shinners 1962)	**West coast:**	
Hypericum cumulicola	*Eriogonum longifolium* var. *gnaphalifolium*	*Chrysopsis floridana*	
Liatris ohlingerae	*Lechea divaricata*	**Panhandle coast:**	
Paronychia chartacea	*Lechea cernua*	*Chrysopsis gossypina* ssp. *cruiseana*	
Polygonella basiramea	*Nolina brittoniana*-	*Lupinus westianus* var. *westianus*	
Polygonella myriophylla	*Polygala lewtonii*	*Polygonella macrophylla*	
Prunus geniculata	*Schizachyrium niveum*		
Ziziphus celata (POLK/HIGH)	*Stylisma abdita*		
	Warea carteri		

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