



Gold Head Branch State Park (Clay County)

Photo by Gary Knight

## **Sandhill**

**Description:** Sandhill is characterized by widely spaced pine trees with a sparse midstory of deciduous oaks and a moderate to dense groundcover of grasses, herbs, and low shrubs. Sandhill occurs on the rolling topography and deep sands of the Southeastern U.S. Coastal Plain. Typical associations or indicator species are longleaf pine (*Pinus palustris*), turkey oak (*Quercus laevis*), and wiregrass (*Aristida stricta* var. *beyrichiana*). On the southern Lake Wales Ridge, South Florida slash pine (*P. elliottii* var. *densa*) may replace longleaf pine. The midstory trees and low shrubs can be sparse to dense, depending on fire history, and may include turkey oak, bluejack oak (*Q. incana*), sand live oak (*Q. geminata*), sand post oak (*Q. margaretta*), saw palmetto (*Serenoa repens*), sparkleberry (*Vaccinium arboreum*), dwarf huckleberry (*Gaylussacia dumosa*), pricklypear (*Opuntia humifusa*), and gopher apple (*Licania michauxii*). Earleaf greenbrier (*Smilax auriculata*) is the most common woody vine that occurs in sandhill. The greatest plant diversity within sandhill is in the herbaceous groundcover. Dominant grasses, in addition to wiregrass, include other three-awns (*Aristida* spp.), pineywoods dropseed (*Sporobolus junceus*), lopsided indiangrass (*Sorghastrum secundum*), several species of bluestems (*Andropogon* spp.), and little bluestem (*Schizachyrium scoparium*). The latter is especially common in portions of the western Florida Panhandle where it can replace wiregrass (Kindell et al. 1997). Bracken fern (*Pteridium aquilinum*) can be common. Typical forbs include dogtongue wild buckwheat (*Eriogonum tomentosum*) and such Aster family taxa as narrowleaf silkgrass (*Pityopsis graminifolia*), gayfeathers and blazing stars (*Liatris* spp.), coastalplain honeycomb-head (*Balduina angustifolia*), sweet goldenrod (*Solidago odora*), and soft green eyes (*Berlandiera pumila*). Legumes

also make up an important component of the sandhill groundcover. Typical species include sidebeak pencil flower (*Stylosanthes biflora*), sensitive brier (*Mimosa quadrivalvis* var. *angustata*), summer farewell (*Dalea pinnata*), milkpeas (*Galactia* spp.), snoutbeans (*Rhynchosia* spp.), spurred butterfly pea (*Centrosema virginianum*), and Atlantic pigeon-wing (*Clitoria mariana*).

Sandhill occurs on crests and slopes of rolling hills and ridges with steep or gentle topography. Soils are deep, marine-deposited, often yellowish sands that are well-drained and relatively infertile. Sandhill is important for aquifer recharge because the porous sands allow water to percolate rapidly with little runoff and minimal evaporation. The deep, sandy soils and a lack of near surface hardpan or water table contribute to a xeric environment. Sandhill requires growing season fires to maintain open structure.

**Characteristic Set of Species:** longleaf pine, turkey oak, wiregrass

**Rare Species:** Rare plants in sandhill vary across Florida. Peninsular sandhill supports Florida toothache-grass (*Ctenium floridanum*), clasping warea (*Warea amplexifolia*), scrub stylisma (*Stylisma abdita*), giant orchid (*Pteroglossaspis ecristata*), longspurred mint (*Dicerandra cornutissima*), variable-leaf crownbeard (*Verbesina heterophylla*), and scrub pigeon-wing (*Clitoria fragrans*). Panhandle sandhill supports zigzag silkgrass (*Pityopsis flexuosa*), toothed savory (*Calamintha dentata*), sandhill sedge (*Carex tenax*), pineland hoary-pea (*Tephrosia mohrii*), hairy wild indigo (*Baptisia calycosa* var. *villosa*) and, in the ecotone and upper ridges between sandhill and upland hardwood forest, Arkansas oak (*Q. arkansana*).

Sandhill provides important habitat for many rare animals such as gopher frog (*Rana capito*), gopher tortoise (*Gopherus polyphemus*), eastern indigo snake (*Drymarchon couperi*), Florida pine snake (*Pituophis melanoleucus mugitus*), short-tailed snake (*Stilosoma extenuatum*), Eastern diamondback rattlesnake (*Crotalus adamanteus*), red-cockaded woodpecker (*Picoides borealis*), southeastern American kestrel (*Falco sparverius paulus*), Florida mouse (*Podomys floridanus*), and southeastern and Sherman's fox squirrels (*Sciurus niger niger* and *S. niger shermani*, respectively). Several rare invertebrates species occur in sandhill including Florida deepdigger scarab beetle (*Peltotrupes profundus*), Ocala deepdigger scarab beetle (*Peltotrupes youngi*), north peninsular mycotrupes beetle (*Mycotrupes gaigei*), Skelley's june beetle (*Phyllophaga skelleyi*), pygmy anomala scarab beetle (*Anomala exigua*), McCrone's burrowing wolf spider (*Geolycosa xera*), and several species of melanoplus grasshoppers including pygmy sandhill grasshopper (*Melanoplus pygmaeus*) and Tequesta grasshopper (*Melanoplus tequestae*). The gopher tortoise and southeastern pocket gopher (*Geomys pinetis*) are an especially important keystone species in sandhills. Gopher tortoise burrows are used as shelter by more than 60 species of vertebrates and 300 species of invertebrates (Jackson and Milstrey 1989) and have commensal species of invertebrates. Many invertebrate species, including at least a dozen rare beetle species are commensals in southeastern pocket gopher burrows (Skelley, pers. comm. 2009).

**Range:** In Florida, sandhill occurs predominantly in the northern half of the state, extending south to Volusia County along the Atlantic coast, with a disjunct occurrence in Martin County, and to Manatee County on the Gulf coast. In the interior peninsula of Florida, sandhill is concentrated along, but not restricted to, high ridges (e.g., Brooksville

and Trail Ridges and extends south along the Lake Wales Ridge to Highlands County (Myers 1990).

Sandhill was historically widespread on well-drained sands throughout the Southeastern U.S. Coastal Plain and was once a major part of an extensive mosaic of longleaf pine-dominated natural communities. This longleaf pine ecosystem has experienced a 98 percent decline in acreage throughout its range, and is considered 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 a dominant environmental factor in sandhill ecology (Myers 1990). Frequency, intensity, and season are important fire characteristics that influence community structure and species composition (Myers 1990). Frequent low-intensity ground fires in the growing season reduce hardwood competition and perpetuate pines and grasses (Platt et al. 1988; Robbins and Myers 1992). Provencher et al. (2003) found that herbaceous and faunal species diversity in sandhill increases with application of prescribed fires in areas where fire had long been excluded. The natural or historic frequency of fire in sandhill is every 1-3 years (Frost 1998).

In the absence of regular fire, the abundance and density of sandhill shrubs and small trees such as turkey oak increases, and sand live oak, laurel oak (*Q. hemisphaerica*) or sand pine (*P. clausa*) can invade. Lack of fire may ultimately lead to the development of a xeric hammock, turkey oak barrens, or sand pine-dominated sandhill. The resulting dense woody vegetation reduces the herbaceous groundcover and, consequently, the fine fuels needed to carry low-intensity ground fires.

**Community Variations:** Southern Ridge Sandhill occurs in south-central Florida along the Lake Wales Ridge. It is distinguished by the presence of South Florida slash pine in the canopy, abundant scrub hickory (*Carya floridana*) and evergreen oaks in the understory, and stunted turkey oaks (Myers and White 1987). Turkey oak barrens can occur in areas of irregular fire. In sandhill adjacent to scrub, sand live oak, Chapman's oak (*Q. chapmanii*), myrtle oak (*Q. myrtifolia*), and Florida rosemary (*Ceratiola ericoides*) may be present (e.g., Warea Tract of Seminole State Forest). In some examples, the occurrence of these species may reflect invasion as a result of infrequent fire (Myers 1990). Several examples of sandhill in Florida support old growth longleaf pine and exemplify the presumed historical community structure and composition (e.g., Eglin Air Force Base, Patterson Natural Area and Extension and Mike Roess Gold Head Branch State Park).

**Associated Communities:** Sandhill is often associated with and grades into scrub, scrubby flatwoods, mesic flatwoods, upland pine, upland mixed woodland, or xeric hammock. Sandhill differs from scrubby flatwoods by the presence of deciduous midstory oaks (turkey oak, bluejack oak, or sand post oak), and the absence or infrequent occurrence of scrub oaks (Chapman's oak, myrtle oak). Sandhill is distinguished from upland pine (found in northern Florida only) by having sandy rather than clayey or loamy soil texture and by the absence of southern red oak (*Q. falcata*) and flowering dogwood (*Cornus florida*). Upland mixed woodland can develop in the ecotone between sandhill and upland hardwood forests and is dominated by a partially closed canopy of pines,

large oaks such as southern red oak, post oak (*Q. stellata*), and blackjack oak (*Q. marilandica*), mockernut hickory (*Carya alba*), and sparse, if any, wiregrass. Long unburned sandhill, in which xeric oaks form a closed canopy, may be indistinguishable from xeric hammock. The presence of longleaf pine, turkey oak, and wiregrass are helpful in distinguishing sandhill from xeric hammock. In some areas, wet prairies or seepage slopes, dominated by cutthroat grass (*Panicum abscissum*) or pitcherplants (*Sarracenia* spp.), occur as wetter inclusions at the bases of sandhill slopes.

**Management Considerations:** Frequent fires are essential for the conservation of native sandhill flora and fauna. In order to maintain (or restore) natural historic conditions, prescribed fire should be applied in sandhill on a 1-3 year interval. Variability in the season, frequency, and intensity of fire is also important for preserving species diversity, since different species in the community flourish under different fire regimes (Myers 1990; Robbins and Myers 1992). Frequent fires reduce ground litter and prevent hardwood and shrub encroachment into the midstory, thereby allowing ample sunlight to reach the forest floor. This is essential for the regeneration and maintenance of longleaf pines, as well as the native grasses, herbs, and low shrubs that characterize sandhill communities. It is important to recognize, however, that too many years of closely spaced burns ( $\leq 1$  year) may decrease species diversity.

By comparison, fires that consistently trend toward longer burn intervals ( $> 3$  years) can allow for a build-up of fuel loads and a greater potential for lethal heat-release temperatures. 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). Unnaturally high tree mortality, particularly of larger, older trees, can be a concern when fire is reintroduced in long-unburned sites with dense midstory and high duff accumulation (Varner et al. 2005). Reducing dense vegetation and removing duff around larger pines is one option for protecting canopy trees. Application of multiple low-intensity fires over a series of years is another effective means for gradually reducing accumulations of duff and heavier fuels while minimizing tree mortality. These considerations are particularly important in locations where older canopy trees are rare due to past timbering or fire exclusion practices (Varner et al. 2005).

Avoiding widespread soil disturbance, such as mechanical roller chopping, can prevent the establishment of weedy species and protect the existing, established native groundcover (Provencher et al. 2001). This groundcover, especially wiregrass, is unlikely to recover if it is lost (Myers 1990; Cox et al. 2004) and may require reintroduction through seeding or direct planting, both of which are labor-intensive and expensive.

In areas where fire exclusion has resulted in heavy midstory hardwood and shrub encroachment, reduction of the midstory by fire, or a combination of fire and mechanical or chemical treatment may be appropriate (Hay-Smith and Tanner 1994). In a study comparing three hardwood midstory removal techniques in sandhill (fire alone, mechanical + fire, herbicide + fire), Provencher et al. (1999) found that prescribed fire alone in the growing season was the most cost effective method at Eglin Air Force Base. The use of herbicides (ULW<sup>®</sup> form of hexazinone), while more expensive, has also been

effective on hardwood mortality (Hay-Smith and Tanner 1999) especially when followed with prescribed fire (Provencher et al. 1999). This method, however, had negative effects on several understory species in Eglin sandhill, including legumes (Fabaceae), gopher apple, huckleberry, and little bluestem, reduced the overall richness of groundcover species (Provencher et al. 1999), and reduced the biomass of wiregrass due to an initial top-kill (Hay-Smith and Tanner 1999). Provencher also found that mechanical midstory removal (chainsaw felling of oaks) reduced woody species density but was no more effective at increasing groundcover diversity than burning alone.

Invasive exotic plants are another management concern in sandhill. Cogon grass (*Imperata cylindrica*; Van Loan et al. 2002), centipedegrass (*Eremochloa ophiuroides*), mimosa (*Albizia julibrissin*), and natal grass (*Melinis repens*) are especially problematic invaders of sandhill. Lippincott (1997) found that cogon grass invasion in sandhill reduced soil moisture and increased fuel loads. This ultimately led to higher intensity fires that resulted in greater mortality of juvenile longleaf pine as compared to non-invaded sandhill.

**Exemplary Sites:** Eglin Air Force Base (Santa Rosa, Okaloosa, and Walton counties), Mike Roess Gold Head Branch State Park (Clay County), “Riverside Island” in the northern half of the Ocala National Forest (Marion County), “Red Hill” on Archbold Biological Station (Highlands County), Wekiwa Springs State Park (Orange County), and portions of the Citrus Tract in Withlacoochee State Forest (Citrus County), Tiger Creek Preserve (Polk County), St. Marks National Wildlife Refuge (Wakulla County)

**Global and State Rank:** G3/S2

**Crosswalk and Synonyms:**

Kuchler	112/southern mixed forest
Davis	6/forests of longleaf pine and xerophytic oaks
SCS	4/longleaf pine - turkey oak hills
Myers and Ewel	High pine – sandhill and southern ridge sandhill
SAF	70/longleaf pine
	71/longleaf pine - scrub oak
	72/southern scrub oaks
FLUCCS	412/longleaf pine - xeric oak
	421/xeric oak
Whitney	High pine grasslands

**References:**

Stein, B.A., L.S. Kutner, and J.S. Adams, editors. 2000. Precious Heritage: The Status of Biodiversity in the United States. Oxford University Press, USA, New York.

Cox, A.C., D.R. Gordon, J.L. Slapcinsky, and G.S. Seamon. 2004. Understory restoration in longleaf pine sandhills. *Natural Areas Journal* 24:4-14.

Frost, C.C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. Pages 70-81 in T.L. Pruden and L.A. Brennan, editors. *Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription*.

- Tall Timbers Fire Ecology Conference Proceedings, No. 20. Tall Timbers Research Station, Tallahassee, Florida.
- Hay-Smith, L., and G.W. Tanner. 1999. Restoring longleaf pine sandhill communities with an herbicide. Publication Document WEC-131. University of Florida, Department of Wildlife Ecology and Conservation, Institute of Food and Agricultural Sciences, Gainesville, Florida.
- Jackson, D.R., and E.G. Milstrey. 1989. The fauna of gopher tortoise burrows. Pages 86-98 in J.E. Diemer, D.R. Jackson, J.L. Landers, J.N. Lane, and D.A. Wood, editors. Gopher Tortoise Relocation Symposium Proceedings, Nongame Wildlife Program Technical Report #5. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.
- Kautz, R.S. 1998. Land use and land cover trends in Florida 1936-1995. *Florida Scientist* 61:171-187.
- Kindell, C.E., B.J. Herring, C. Nordman, J. Jensen, A.R. Schotz, and L.G. Chafin. 1997. Natural community survey of Eglin Air Force Base, 1993-1996: Final Report. Florida Natural Areas Inventory, Tallahassee, Florida Natural Areas Inventory, Tallahassee, Florida.
- Lippincott, C.L. 1997. Ecological consequences of *Imperata cylindrica* (cogongrass) invasion in Florida sandhill. Dissertation, University of Florida, Gainesville.
- Myers, R.L. 1990. Scrub and high pine. Pages 150-193 in R.L. Myers and J.J. Ewel, editors. *Ecosystems of Florida*. University of Central Florida Press, Orlando.
- Myers, R.L., and D.L. White. 1987. Landscape history and changes in sandhill vegetation in north-central and south-central Florida. *Bulletin of the Torrey Botanical Club* 114:21-32.
- Noss, R.F., E.T. LaRoe, III, and J.M. Scott. 1995. Endangered ecosystems of the United States: a preliminary assessment of loss and degradation. Biological Report 28. United States Department of Interior, National Biological Service, Washington, D.C.
- Platt, W.J., G.W. Evans, and M.M. Davis. 1988. Effects of fire season on flowering of forbs and shrubs in longleaf pine forests. *Oecologia* 76:353-363.
- Provencher, L., K.E.M. Galley, B.J. Herring, J.P. Sheehan, N.M. McAdoo, S.J. Gobris, A.R. McAdoo, A.R. Litt, G.W. Gordon, G.W. Tanner, L.A. Brennan, and J.L. Hardesty. 1999. Effects of hardwood reduction on trees and community similarity and sand pine harvest on groundcover vegetation in longleaf pine sandhills at Eglin Air Force Base. Science Division, The Nature Conservancy, Gainesville, Florida.

- Provencher, L., A.R. Litt, K.E.M. Galley, D.R. Gordon, G.W. Tanner, L.A. Brennan, N.M. Gobris, S.J. McAdoo, J.P. McAdoo, and B.J. Herring. 2001. Restoration of fire-suppressed longleaf pine sandhills at Eglin Air Force Base, Florida. Final report to the Natural Resources Management Division, Eglin Air Force Base. The Nature Conservancy, Gainesville, Florida.
- Provencher, L., A.R. Litt, and D.R. Gordon. 2003. Predictors of species richness in northwest Florida longleaf pine sandhills. *Conservation Biology* 17:1660-1671.
- Robbins, L.E., and R.L. Myers. 1992. Seasonal effects of prescribed burning in Florida: a review. Miscellaneous Publication No. 8. Tall Timbers Research Station, Tallahassee, Florida.
- Rothermel, R.C. 1983. How to predict the spread and intensity of forest and range fires. General Technical Report INT-143. United States Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Skelley, P. Collections Manager, Florida Department of Agriculture and Consumer Services - Florida State Collection of Arthropods. Personal Communication. 2009
- Thompson, W. Central region conservation director, The Nature Conservancy, Florida Chapter. Personal Communication. 2006
- Van Loan, A.N., J.R. Meeker, and M.C. Minno. 2002. Cogon grass. Pages 353-364 in R. Van Driesche, S. Lyon, B. Blossey, M. Hoddle, and R. Reardon, editors. Biological control of invasive plants in the eastern United States. Publication FHTET-2002-04. United States Department of Agriculture Forest Service.
- Varner, J.M., D.R. Gordon, F.E. Putz, and J.K. Hiers. 2005. Restoring fire to long-unburned *Pinus palustris* ecosystems: novel fire effects and consequences for long-unburned ecosystems. *Restoration Ecology* 13:536-544.



Archbold Biological Station (Highlands County)

Photo by Eric S. Menges