USDA Natural Resources
Conservation Service

Ecological site F154XA004FL
Moist Sandy Pine-Hardwood Woodlands

Last updated: 2/21/2024
Accessed: 05/17/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 154X–South-Central Florida Ridge

MLRA 154 is entirely in Peninsular Florida, and contains 8,285 square miles. The landscape of MLRA 154 is characterized by a series of parallel, prominent sandy ridges of Pleistocene marine origin, including the Brooksville and Mount Dora Ridges. These North to South oriented parallel ridges are interspersed with more low lying physiographic provinces, including: upland hills, plains, valleys and gaps (Puri and Vernon 1964). The extreme western portion of the MLRA consists of thin belt of coastal lowlands and marshlands.

Many of the soils of MLRA 154 are Pleistocene or Holocene sands that are underlain with older, loamy Pliocene marine sediments (Cypresshead formation) or the clayey Miocene marine sediments (Hawthorne formation). A combination of marine depositional events and the dissolution of underlying limestone (karst geology) is responsible for surficial topography throughout Peninsular Florida.

Classification relationships

All portions of the geographical range of this site falls under the following ecological / land classifications including:

-Environmental Protection Agency's Level 3 and 4 Ecoregions of Florida: 75 Southern Coastal Plain; 75c Central Florida Ridges and Uplands (Griffith, G. E., Omernik, J. M., & Pierson, S. M., 2013)

-Florida Natural Area Inventory, 2010 Edition: Sandhill - mesic variant, Upland Pine, Upland Mixed Woodland, and Upland Hardwood Forest (FNAI, 2010)

Ecological site concept

Soils of the Moist Sandy Pine-Hardwood Woodlands are deep, yellow, and acidic. They are variously classified as sandy, sandy over loamy, or sandy over clayey upland soils. The map unit components occur on slopes of < 8% (ranging up to 12%). This concept includes very deep, somewhat poorly drained to well drained map units (Adamsville, Albany, Apopka, Arredondo, Blanton, Bonneau, Chipley, Duplin, Florahome, Fort Meade, Jumper, Kendrick, Lochloosa, Lutterloh, Mabel, Masaryk, Micanopy, Millhopper, Moriah, Nobleton, Norfolk, Ocilla, Orlando Variant, Otela, Ridgewood, Seffner, Sparr, Sumterville, Tavares, Troup, Wadley, and Wicksburg). This site is extensive on the Brooksville Ridge, Cotton Plant Ridge, Mount Dora Ridge, Northern Highlands, Ocala Hill, Marion Upland, and Sumter Upland physiographic units, and to a lesser extent in the Central and Western Valleys. The overall extent of this site is approximately 600,000 acres.

This concept is distinct because of its native condition (i.e., reference site vegetation), component soils, successional patterns, and wildlife habitat. Reference site vegetation of this site is edaphically supported by very deep, yellow sands with a moderately deep or deep seasonal high water table.

The Moist Sandy Pine-Hardwood Woodlands encompass a wide breadth of environmental and vegetation conditions, and natural disturbance regimes. In general, natural vegetation of this concept ranges from open pine woodland to closed forested conditions, depending on landscape position, soil moisture and fertility, and fire frequency.

Associated sites

R154XX001FL	**Yellow Sands Xeric Uplands** These sites are excessively drained communities that occur in higher, drier, xeric landscape positions
F154XX002FL	**Xeric Bicolor Sandy Uplands** These sites are excessively drained communities that occur in higher, drier, xeric landscape positions
F154XA003FL	**Dry Yellow Sands Pine Woodland** These sites are excessively drained communities that occur in higher, drier, xeric landscape positions
F154XA005FL	**Poorly Drained Upland Pine-Hardwood Forests** These are poorly drained communities that occur in lower, wetter landscape positions
F154XA007FL	**Moist Sandy Wet-Mesic Flatwoods** These are poorly drained communities that occur in lower, wetter landscape positions
F154XA008FL	**Moist Sandy Scrubby Flatwoods** These sites are somewhat poorly to well drained communities that occur in similarly mesic landscape positions
F154XA009FL	**Moist Basic Pine Uplands** These sites are moderately well to well drained communities that occur in slightly higher, drier landscape positions
F154XA010FL	**Moist Lithic Flatwoods And Hammocks** These sites are somewhat poorly to well drained communities that occur in similarly mesic landscape positions
F154XA011FL	**Wet Lithic Flatwoods And Hammocks** These are poorly drained communities that occur in lower, wetter landscape positions

Similar sites

F154XA009FL	**Moist Basic Pine Uplands** These sites occur on similar landscapes in slightly better drained positions. Greater amounts of finer textured materials and high base status result in greater soil fertility and available water capacity.
F154XA010FL	**Moist Lithic Flatwoods And Hammocks** These sites occur on similar landscapes with similar soil drainage. These soils will have a shallow to moderately deep rooting restriction that will influence plant community characteristics and soil chemistry.
F154XA012FL	**Wet Rich Forests And Woodlands** These sites occur on similar landscapes with similar soil drainage. The presence of a subsurface loamy or clayey layer will be shallower than Site 004, resulting in higher available water capacity and greater plant community production.

Table 1. Dominant plant species

Tree	(1) *Pinus palustris*
Shrub	(1) *Quercus falcata* (2) *Cornus florida*
Herbaceous	(1) *Schizachyrium scoparium* (2) *Dichanthelium commutatum*

Physiographic features

The physiography of the area is among the best defined in Peninsular Florida with rolling topography consisting of ridges, hills, and dunes interspersed with low-lying valleys, depressions, and drainageways. The entire area is located within the Floridian Section of the Coastal Plain Province of the Atlantic Plain. Elevations of this site range from sea level to 295 feet (0 to 90 m). This site occurs on somewhat poorly to well-drained uplands. Slopes are nearly level to sloping (0 to 12%). The site occurs on elevated ridges and hills of marine deposition. The soils are sandy, sandy over loamy, or sandy over clayey to > 80 inches.

Table 2. Representative physiographic features

Hillslope profile	(1) Backslope (2) Footslope (3) Summit (4) Shoulder
Landforms	(1) Marine terrace > Ridge (2) Marine terrace > Hill
Runoff class	Very low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	2–76 m
Slope	0–8%
Water table depth	30–183 cm
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	0–90 m
Slope	0–12%
Water table depth	30–203 cm

Climatic features

The climate varies considerably across the latitudinal gradient of MLRA 154. The north to south orientation of MLRA 154 spans three USDA plant hardiness zones in the Florida Peninsula (USDA-ARS).

The climate is characterized by humid subtropical with long hot summers and mild winters. In the winter months, Canadian air masses move across Peninsular Florida and produce cool, cloudy, rainy weather. Below freezing temperatures are occasional in the northern part of the MLRA, but very rare in the southern. Overall, there are typically fewer than 30 days of the year with below freezing temperatures in MLRA 154.

Similarly, average temperatures vary considerably from north to south over the range of the site. Average seasonal low temperature in the north is 12.7°C in January, and prolonged freezing temperatures are common in the winter months. In contrast, the south has more uniformity of seasonal temperatures and winter freezes are rare.

Precipitation in MLRA 154 is distributed fairly evenly throughout the year. Average annual precipitation ranges from 50 to 55 inches (127 to 140 cm). The highest monthly precipitation occurs from June through October, with June through August being the wettest period. However, the northern gradients receive substantially more precipitation during the winter months compared to the southern. Winter rainfall is associated with seasonal cold fronts, which tend to disintegrate before reaching the southern reaches of MLRA 154.

Hurricanes and tropical storms affect much of MLRA 154. Catastrophic hurricanes make landfall along the Atlantic coast of Peninsular Florida on the order of 2 to 4 time per century. Strong winds and heavy rainfall affect the interior peninsula; rainfall from hurricanes and tropical systems vary widely but can exceed 20 inches (51 cm) from one event. Hurricanes are most likely to occur between June and November and are most common in August and September.

Table 4. Representative climatic features

Frost-free period (characteristic range)	255-365 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	1,295-1,346 mm
Frost-free period (actual range)	215-365 days
Freeze-free period (actual range)	303-365 days
Precipitation total (actual range)	1,270-1,372 mm
Frost-free period (average)	312 days
Freeze-free period (average)	354 days
Precipitation total (average)	1,321 mm

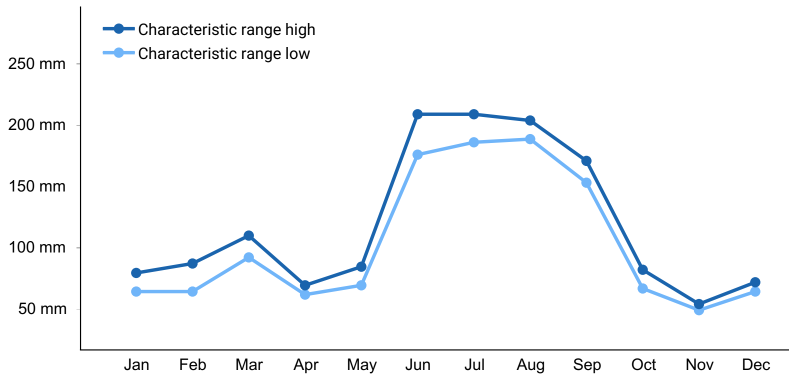

Figure 1. Monthly precipitation range

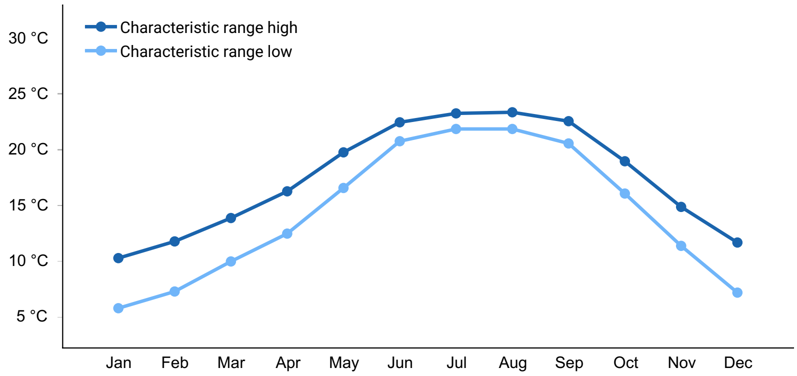

Figure 2. Monthly minimum temperature range

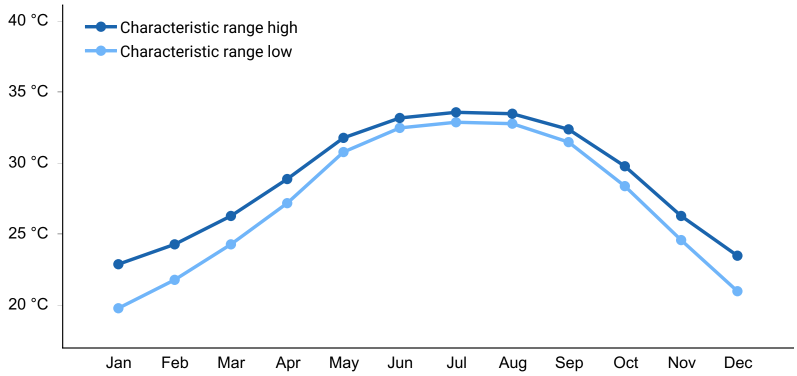

Figure 3. Monthly maximum temperature range

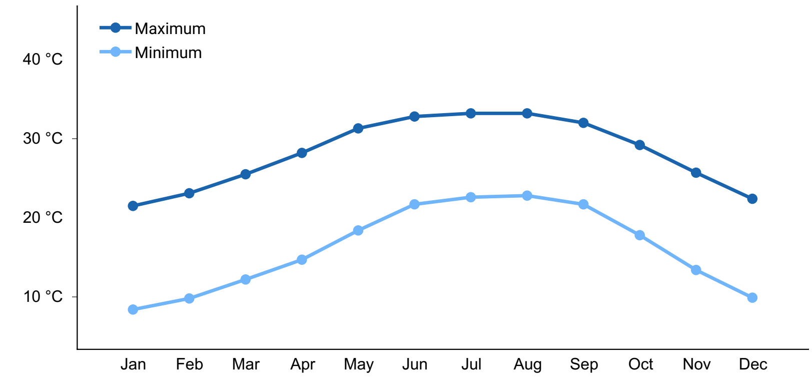

Figure 4. Monthly average minimum and maximum temperature

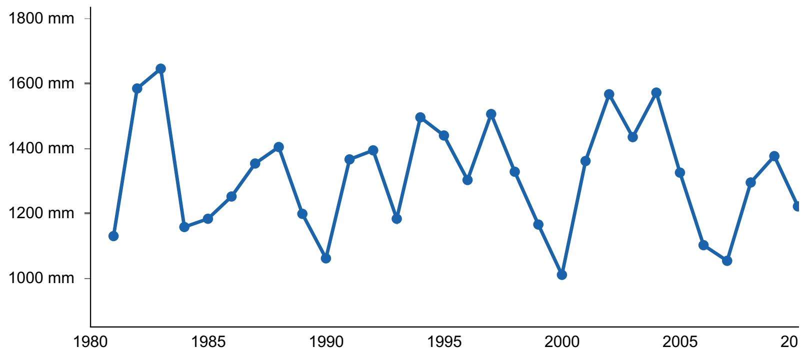

Figure 5. Annual precipitation pattern

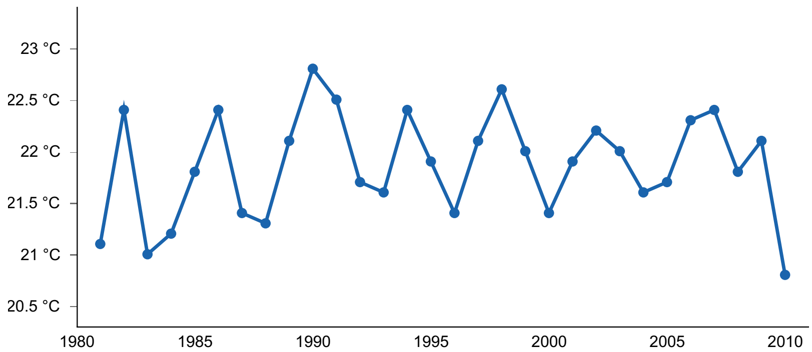

Figure 6. Annual average temperature pattern

Climate stations used

- (1) ORANGE SPRINGS 2SSW [USC00086618], Fort Mc Coy, FL
- (2) GAINESVILLE 11 WNW [USC00083322], Gainesville, FL
- (3) INVERNESS 3 SE [USC00084289], Inverness, FL
- (4) PLANT CITY [USC00087205], Plant City, FL
- (5) BROOKSVILLE CHIN HILL [USC00081046], Brooksville, FL
- (6) MTN LAKE [USC00085973], Lake Wales, FL
- (7) TARPON SPGS SEWAGE PL [USC00088824], Tarpon Springs, FL
- (8) BARTOW [USC00080478], Bartow, FL
- (9) LISBON [USC00085076], Leesburg, FL
- (10) WINTER HAVEN [USC00089707], Winter Haven, FL

Influencing water features

The modal concept for this site is extensive areas of ridges and hills surrounded by wetter ecological sites. Hydrology surrounding this site can influence species composition. The site is situated on soils that have a shallow to deep seasonal high water tables (dominantly > 12 to 72 inches, but ranges to 80 inches). Subsurface water flow is dependent on the presence or absence of an aquitard (loamy or clayey layer). The presence, depth, and orientation of this water restrictive layer may affect subsurface water movement.

Given the extensive nature of this site and adjacent sites with similar or dissimilar hydrologic properties, this site can have either an abrupt ecotone or a very diffuse ecotone.

Hydrogeomorphically, these sites are members of upland landscape units receiving water through only local precipitation, and discharging water through the soil to adjacent wetter sites or the Florida Aquifer. Slope gradient, rapid or very rapid infiltration and slow to rapid saturated hydraulic conductivity results in negligible to high surface runoff. The combination of a shallow to deep water table, underlying loamy or clayey material, and low or moderate available water are the keys to this site’s plant communities.

Soil features

Soils are dominantly somewhat poorly to well drained; sandy, sandy over loamy, or sandy over clayey. Components within this site classify as Grossarenic or Arenic Paleudults (Apopka, Arredondo, Blanton, Bonneau, Kendrick, Millhopper, Sparr, Wadley, Wicksburg), Grossarenic Paleudalfs (Lutterloh, Otela), Humic Psammentic Dystrudepts (Florahome, Fort Meade), and Aquic Quartzipsamments (Adamsville, Chipley, Ridgewood, Tavares). Minor taxa within this site are Albaquic Hapludalfs (Mabel), Aquic Paleudalfs (Micanopy), Aquic Paleudults (Duplin), Aquic Arenic Hapludalfs (Moriah), Aquic Arenic Paleudults (Albany, Lochloosa), Arenic Plinthaquic Paleudults (Jumper), Quartzipsammentic Haplumbrepts (Orlando Variant), Typic or Grossarenic Kandiudults (Norfolk, Troup), and Aquic Humic Dystrudepts (Seffner).

These soils formed mainly from sandy marine sediments of varying thickness that are underlain with loamy or clayey marine sediments. The dominant representative slope for the correlated soil components is 0 to 8% but ranges up to 12%. Mineralogy is siliceous or mixed.

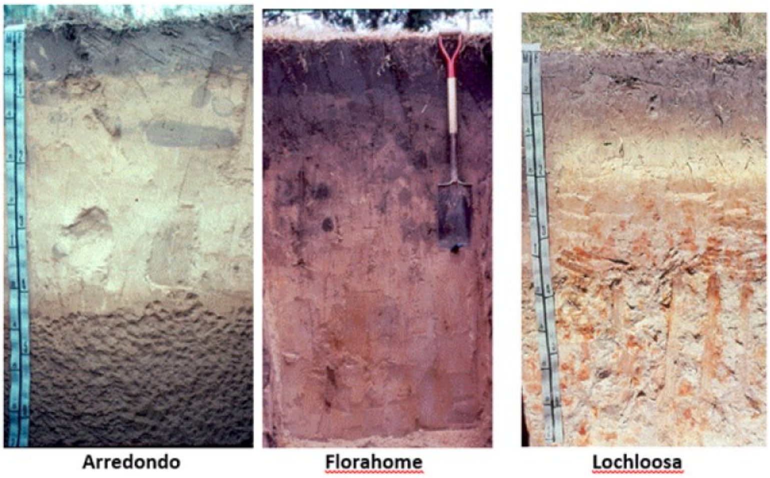

Figure 7. Soil profiles

Table 5. Representative soil features

Parent material	(1) Eolian deposits (2) Marine deposits
Surface texture	(1) Fine sand (2) Sand (3) Loamy fine sand (4) Loamy sand
Drainage class	Somewhat poorly drained to well drained
Permeability class	Rapid to very rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%

Available water capacity (0-101.6cm)	3.05–13.21 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–1
Soil reaction (1:1 water) (0-101.6cm)	4.8–5.9
Subsurface fragment volume <=3" (0-101.6cm)	0–3%
Subsurface fragment volume >3" (0-101.6cm)	0–7%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Slow to very rapid
Soil depth	135–203 cm
Surface fragment cover <=3"	0–3%
Surface fragment cover >3"	0–4%
Available water capacity (0-101.6cm)	Not specified
Calcium carbonate equivalent (0-101.6cm)	0–20%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–4
Soil reaction (1:1 water) (0-101.6cm)	3.5–8.4
Subsurface fragment volume <=3" (0-101.6cm)	Not specified
Subsurface fragment volume >3" (0-101.6cm)	Not specified

Ecological dynamics

Reference State (State 1) vegetation associated with the Moist Sandy Pine-Hardwood Woodlands include pine and pine-hardwood dominated woodlands. In general, this concept spans a range of pineland community types, including the more mesic variant of longleaf pine sandhills, upland pine woodlands, and upland mixed woodlands (FNAI, 2010). The woodland or forest composition and structure of this site are also dependent on local and regional geography. Many upland hardwoods reach the southern limits of their range in North and Central Florida.

Fire is the dominant disturbance factor driving ecological dynamics of the Moist Sandy Pine-Hardwood Woodlands site. Before European settlement, upland pine and pine-hardwood woodlands burned frequently and with some regularity; estimated fire return intervals range from once per 1 to 5 years (Myers, 1990; Robbins and Myers, 1992; Platt, 1999; Glitzenstein et al., 2003). Abundant herbaceous ground cover vegetation provides fine fuels needed to carry frequent ground fires. Frequent ground fires affect woodland ecology in many ways: preparation of seedbed for germination of longleaf pine and other native species; stimulation of seed production in many species of grasses and forbs; maintenance of open stand conditions needed for sun-loving plant species; and reduced growth of hardwoods and non-native species (Abrahamson, 1984; Walker and Peet, 1983; Wade and Lundsford, 1990;

Waldrop et al., 1992; Outcalt et al., 2002; Glitzenstein et al., 2003; Rienhard and Menges, 2004). Once established in upland woodlands, mature longleaf pines and oaks are resistant to injury from low intensity fire (Glitzenstein et al., 1995).

Changes in fire regimes trigger radical shifts in species composition and abundance in this site. Where fire is infrequent (fire return intervals > 10 years), woody abundance increases dramatically. Fire intolerant hardwoods species dominate the canopy and midstory strata. Fire intolerant hardwood species include water oak (Q. nigra), live oak (Q. virginiana), sweetgum (*Liquidambar styraciflua*), common persimmon (*Diospyros virginiana*), laurel oak (Q. laurifolia) and mockernut hickory (C. alba).

Changes from fire regime alteration affect the physiognomy and ecological dynamics of plant community associated with this site (Glitzenstein et al., 1995; Platt, 1999; Provencher et al., 2000; VanLear et al., 2005). The diversity and abundance of groundcover herbaceous species decreases with infrequent or absent fire, as thick growths of woody plants compete with herbaceous vegetation for light and other resources.

Following long term fire suppression (> 80 years), upland pine and mixed uplands will eventually be replaced by oak dominated closed canopy forests, giving way to upland hardwood forests (FNAI, 2010). Dominant hardwoods may include laurel and live oaks. Herbaceous understory of these forests is very sparse. Understory and midstory strata are dominated by vines and hardwood seedings.

Wind damage associated with hurricanes and strong storms infrequently affect ecological dynamics of Moist Sandy Pine-Hardwood Woodlands. Strong winds can cause local or widespread pine mortality. Although hurricanes usually dissipate before reaching the interior of the peninsula, large storms do affect the region on the order of 2 to 3 per century.

Other natural disturbances that affect Moist Sandy Pine-Hardwood Woodlands include pine and hardwood mortality caused by insects and pathogen. Southern pine beetle (Dendroctonus frontalis; SPB) is a species of bark beetle native to the Southeastern Coastal Plain. Periodically SPB populations increase to epidemic levels and healthy pines are killed as infestations expand. Pine mortality, particularly when coupled with fire suppression, will speed succession to upland hardwood forests.

State and transition model

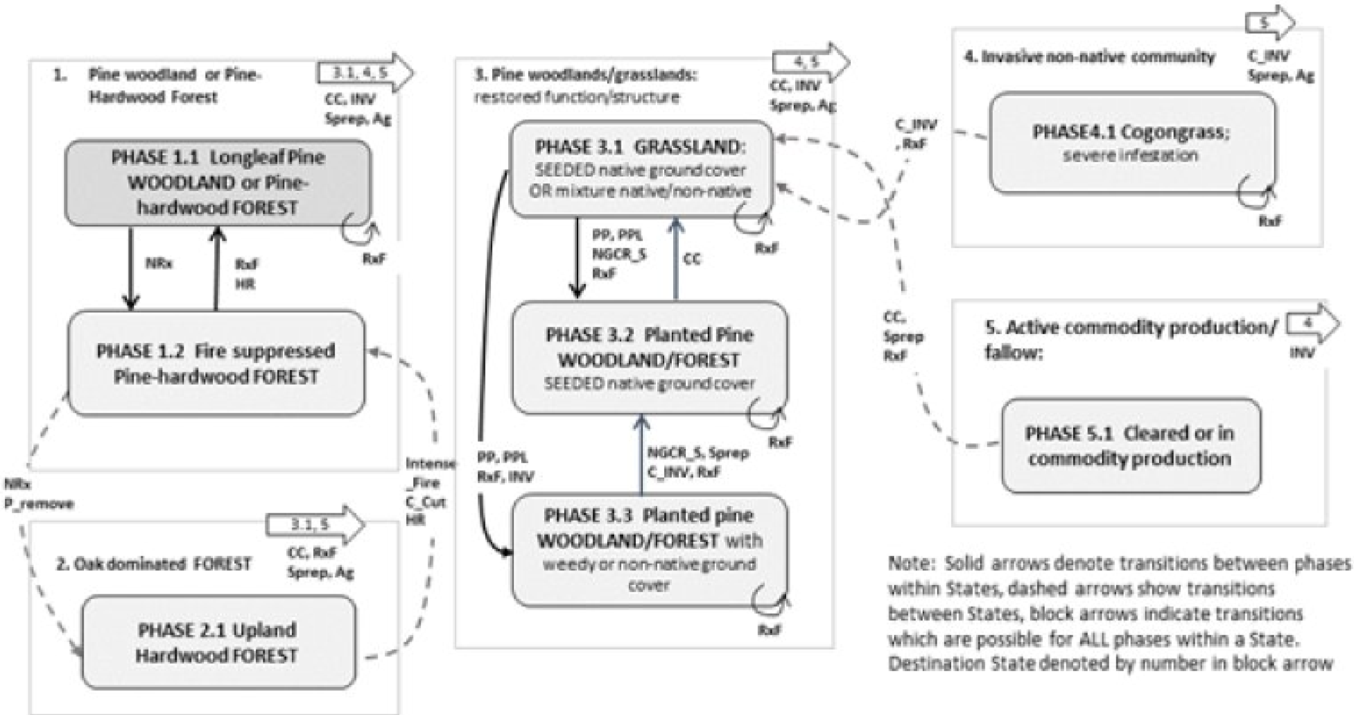

Figure 8. Moist Sandy Pine-hardwood Woodlands

RxF	Frequent interval prescribed fire
Intense_Fire	Infrequent (intense) fire, often stand replacing catastrophic fire
NRx	Fire suppression, or very infrequent non-catastrophic fire
HR	Hardwood reduction (mechanical and chemical, no ground disturbance)
PP	Planted Pine (not Longleaf)
PPL	Planted Pine (Longleaf)
P_remove	Selective logging of pines
CC	Clearcut
Sprep	Site prep (mechanical and chemical)
INV	Invasion of noxious non-native plant species
C_INV	Mechanical/chemical control of invasive plant species
NGCR_S	Native ground cover restoration: active seeding
Ag	Various agricultural practices for crop cultivation

Figure 9. Moist Sandy Pine-hardwood Woodlands Legend

State 1
Upland Pine or Upland Mixed Woodland

The canopy of State 1 contains widely spaced mature longleaf pines (P. palustris) intermixed with patches of regenerating longleaf pine seedlings and saplings. State 1 Upland Pine Woodlands which are frequently burned are mosaics of even-aged longleaf pine “cohorts” with dense patches of pine seedlings distributed in canopy gaps. In State 1 woodlands on more fertile soils and/or less frequently burned sites, hardwoods are co-dominant in the canopy, and more abundant in sub-canopy strata. These hardwood species include oaks of mesic conditions (Southern Red oak, live oak, post oak, sand post oak), hickories (mockernut and pignut hickories), and other species (dogwood, persimmon, sassafras). Many of these hardwood species are somewhat fire tolerant, at least as mature trees. Groundcover vegetation of State 1 is dominated by perennial bunch grasses which form a matrix of mostly continuous cover. Numerous plant species are common in the interstitial spaces between grass tussocks. Wiregrass (*Aristida stricta* var. beyrichiana) is common, and often shares dominance with other bunch grasses, including lopsided indiangrass (*Sorghastrum secundum*), little bluestem (*Schizachyrium scoparium* var. stoloniferum), and other bluestem species (Andropogon spp.). Frequently burned upland pine woodlands are notable for the diversity of groundcover species, particularly herbaceous species of the Aster and legume families.

State 2
Upland Hardwood Forest

State 2 describes late successional vegetation of this concept, resulting from long term fire suppression of longleaf pine sandhill communities (FNAI, 2010). Selective pine removal or increased pine mortality, coupled with fire suppression can accelerate transition to State 2. State 2 Upland Hardwood forests are closed canopy forests of various oak and hickory species, which overtop mid- and under-story vegetation comprised of mainly hardwood seedlings. These lower strata are overwhelmingly dominated by scrub oaks and palmetto (*Serenoa repens*). Other shrub species are variously present, including rusty staggerbush (*Lyonia ferruginea*), sparkleberry (*Vaccinium* *arboreum*), deerberry (*V. stamineum*), black cherry (*Prunus serotina*), American beautyberry (*Callicarpa americana*), common persimmon (*Diospyros virginiana*). Depending on length of fire suppression and geography, Xeric Hammock will often contain remnant species of former longleaf pine sandhills, including turkey oak, bluejack oak, sparkleberry, and remnant wiregrass. Herbaceous ground cover in State 2 is very sparse or absent. The forest floor is covered with leaf litter which holds considerable moisture, creating mesic conditions at ground level and further depressing native herbaceous growth as well as pine germination (FNAI, 2010). With the attenuation of fine fuels in the ground cover, Upland hardwood forests are less likely to carry ground fires. Furthermore, hardwood litter retains ample moisture which deters fire spread.

State 3
Restored Pine Woodlands/Grasslands

State 3 variously describes a grasslands and pine woodlands consisting of seeded and planted native species, OR a mixture of native and non-native herbaceous species. Notably, this state describes conditions where native propagules have been extirpated following long term fire suppression and/or extensive soil disturbance associated with commodity land uses. Native plant populations are purposefully re-established in this state, for the purpose of ecological restoration. The phases of State 3 include grasslands and, if native pines are planted, woodlands with herbaceous ground cover. These plant communities have restored ecological function and provide habitat for native wildlife species. Restoration of native bunchgrasses provides fine fuels for frequent ground fires and is necessary for restoration of ecological site dynamics. Once established, the bunch grass matrix provides habitat suitable for establishment of other native plant populations, either from artificial seeding or natural recruitment. State 3 grasslands and woodlands may provide suitable habitat for ground nesting birds and small mammals.

State 4
Invasive non-native community

State 4 describes a condition where a single noxious non-native species has invaded and dominated the site. By far, the most common noxious invasive plant species of this site is cogongrass (*Imperata cylindrica*; (MacDonald, 2004)). This highly clonal grass spreads rapidly by underground rhizomes and windblown seeds, forming dense circular patches which can become very large (on the order of 100's of acres). Cogongrass grows vigorously in full sunlight (MacDonald, 2004). Furthermore, cogongrass is a prolific seed producer, and readily invades following soil disturbances. (Yager, Miller, and Jones, 2010). Once clones are established, rapid cogongrass growth will extirpate native ground cover plant populations. In addition to its competitive advantage over native vegetation for space and resources, cogongrass may be allelopathic in some situations (Brook, 1989; Bryson and Carter, 1993). Cogongrass is a fire adapted species which burns readily and intensely. Furthermore, it thrives in post-fire conditions where it colonizes rapidly clonally and from seed. Cogongrass fueled fires are up to 20% hotter than natural ground fires of native pinelands (MacDonald, 2004). These hot fires may deter any pine or hardwood regeneration. In the Southeastern U.S., cogongrass does not have any natural herbivore enemies, nor any known pathogens.

State 5
Active commodity production/fallow fields

This state describes commodity land uses of the Moist Sandy Pine-Hardwood Woodlands site. Commodity crops common to Central Florida xeric sands include a variety of annual and perennial crops. Other crops include horticultural ornamentals, vineyards, and some row crops. Pine plantations which are managed for community production of pulpwood or saw timber are included in this state. Also included are improved pastures of bahiagrass (or other sod forming grass species). All phases of State 5 describe conditions following ground penetrating soil disturbance, to the degree that native ground cover is mostly absent. Generally these phases are characterized by the complete extirpation of native ground cover populations, including seed banks and dormant propagules, although native weedy species may persist (mostly annual species). Depending on the severity and frequency of ground disturbance, soil profile characteristics in the upper part of the soil may be altered.

References

. Fire Effects Information System. http://www.fs.fed.us/database/feis/.

. 2021 (Date accessed). USDA PLANTS Database. http://plants.usda.gov.

Other references

Abrahamson, W. G. (1984). Post-fire recovery of Florida Lake Wales ridge vegetation. American journal of botany, 71(1), 9-21.

Brook, R. M. (1989). Review of literature on *Imperata cylindrica* (L.) Raeuschel with particular reference to South East Asia. International Journal of Pest Management, 35(1), 12-25.

Bryson, C. T., & Carter, R. (1993). Cogongrass, *Imperata cylindrica*, in the United States. Weed Technology, 7(4), 1005-1009.

Carr, S. C., Robertson, K. M., & Peet, R. K. (2010). A vegetation classification of fire-dependent pinelands of Florida. Castanea, 75(2), 153-189.

FNAI (2010). Guide to the natural communities of Florida: 2010 edition. Florida Natural Areas Inventory, Tallahassee, FL.

Gilliam, F. S., & Platt, W. J. (1999). Effects of long-term fire exclusion on tree species composition and stand structure in an old-growth Pinus palustris (longleaf pine) forest. Plant Ecology, 140, 15-26.

Glitzenstein, J. S. (2003). Long-Term Seasonal Burning at the St. Marks National Wildlife Refuge, North Florida: Changes in the Sandhill Plots After 23 Years. In 2nd International Wildland Fire Ecology and Fire Management Congress.

Glitzenstein, J. S., Streng, D. R., & Wade, D. D. (2003). Fire Frequency Effects on Longleaf Pine(Pinus palustris P. Miller) Vegetation in South Carolina and Northeast Florida, USA. Natural Areas Journal, 23(1), 22-37.

Glitzenstein, J. S., Platt, W. J., & Streng, D. R. (1995). Effects of fire regime and habitat on tree dynamics in north Florida longleaf pine savannas. Ecological Monographs, 65(4), 441-476.

MacDonald, G. E. (2004). Cogongrass (*Imperata cylindrica*)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380.

Myers, R. L. (1985). Fire and the dynamic relationship between Florida sandhill and sand pine scrub vegetation. Bulletin of the Torrey Botanical Club, 241-252.

Myers, R. L., & White, D. L. (1987). Landscape history and changes in sandhill vegetation in north-central and south-central Florida. Bulletin of the Torrey Botanical Club, 21-32.

Peet, R. K. (2006). Ecological classification of longleaf pine woodlands. The longleaf pine ecosystem, 51-93.

Provencher, L., Galley, K. E., Litt, A. R., Gordon, D. R., Brennan, L. A., Tanner, G. W., & Hardesty, J. L. (2000). Fire, herbicide, and chainsaw felling effects on arthropods in fire-suppressed longleaf pine sandhills at Eglin Air Force Base, Florida. In The Role of Fire in Nongame Wildlife Management and Community Restoration: Traditional Uses and New Directions Proceedings of a Special Workshop (Vol. 2001, p. 24).

Provencher, L., Herring, B. J., Gordon, D. R., Rodgers, H. L., Galley, K. E., Tanner, G. W., ... & Brennan, L. A. (2001). Effects of hardwood reduction techniques on longleaf pine sandhill vegetation in northwest Florida. Restoration Ecology, 9(1), 13-27.

Puri, H. S., & Vernon, R. O. (1964). Summary of the geology of Florida and a guidebook to the classic exposures.

Reinhart, K.O. and E.S. Menges. (2004). Effects of re-introducing fire to a central Florida sandhill community. Applied Vegetation Science, 7: 141-150.

Robbins, L. E., & Myers, R. L. (1992). Seasonal effects of prescribed burning in Florida: a review. Miscellaneous publication/Tall Timbers Research, Inc.(USA).

Rodgers, H. L., & Provencher, L. (1999). Analysis of longleaf pine sandhill vegetation in northwest Florida. Castanea, 138-162.

Schowalter, T. D., Coulson, R. N., & Crossley Jr, D. A. (1981). Role of southern pine beetle and fire in maintenance of structure and function of the southeastern coniferous forest. Environmental Entomology, 10(6), 821-825.

Van Lear, D. H., Carroll, W. D., Kapeluck, P. R., & Johnson, R. (2005). History and restoration of the longleaf pine-grassland ecosystem: implications for species at risk. Forest ecology and Management, 211(1-2), 150-165.

Varner III, J. M., Gordon, D. R., Putz, F. E., & Hiers, J. K. (2005). Restoring fire to long-unburned Pinus palustris ecosystems: novel fire effects and consequences for long-unburned ecosystems. Restoration Ecology, 13(3), 536-544.

Wade, D. D., & Lundsford, J. (1990). Fire as a forest management tool: prescribed burning in the southern United States. Unasylva, 41(3), 28-38.

Waldrop, T. A., White, D. L., & Jones, S. M. (1992). Fire regimes for pine-grassland communities in the southeastern United States. Forest Ecology and Management, 47(1-4), 195-210.

Walker, J., & Peet, R. K. (1984). Composition and species diversity of pine-wiregrass savannas of the Green Swamp, North Carolina. Vegetatio, 55, 163-179.

Yager, L. Y., Miller, D. L., & Jones, J. (2010). Susceptibility of longleaf pine forest associations in south Mississippi to invasion by cogongrass [*Imperata cylindrica* (L.) Beauv.]. Natural areas journal, 30(2), 226-232.

Contributors

Rick Robbins
S. Carr

Approval

Charles Stemmans, 2/21/2024

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/17/2024
Approved by	Charles Stemmans
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

14. **Average percent litter cover (%) and depth (in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

---

17. **Perennial plant reproductive capability:**
