USDA Natural Resources
Conservation Service

# Ecological site PX137X00X070
# Dry Sandy Upland Woodland

Accessed: 05/11/2025

## General information

**Approved**. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

**Figure 1. Mapped extent**

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

## MLRA notes

Major Land Resource Area (MLRA): 137X–Carolina and Georgia Sand Hills

MLRA 137 covers approximately 8,665 square miles (22,450 square kilometers) in the states of South Carolina (44 percent), Georgia (34 percent), and North Carolina (21 percent).

The Sand Hills region occurs below the "fall line", which delineates the older crystalline rocks of the Southern Piedmont (MLRA 136) from the younger sediments of the Southern Coastal Plain (MLRA 133A). The term "fall line" came about because the rivers of the Piedmont cut downward through hard bedrock to meet the lower Coastal Plain sediments. The elevational change is evident in the waterfalls and rapids that occur along this transitional line.

This region is composed of mainly of unconsolidated sediments deposited during the Cretaceous period. Overlying these sediments is the late Miocene to early Pliocene Pinehurst Formation. The Pinehurst Formation is of windblown or eolian origin. Soils in this formation are the subject of this ecological site. Deposits of kaolin and high-silica sands are found across the area and are often mined.

## Classification relationships

This site correlates to Atlantic Coastal Plain Fall-Line Sandhills Longleaf Pine Woodland ecological system (CES203.254) described by NatureServe (NatureServe, 2013). Associations in CES203.254 that correlate to the ecological site are South Atlantic Xeric Longleaf Pine Sandhill (CEGL007844).

It also corresponds to the Sandhills and River Dunes community and Dry Upland Longleaf pine Woodland in Georgia described by Edwards and others (2013) and South Carolina""s Xeric Sandhill Scrub (Nelson, 1986). The hardwood-dominated State 4 corresponds to the Turkey Oak Scrub as part of the larger Dry Longleaf Pineland described by Sorrie (2011). Wharton (1978) describes this community as the Dwarf Oak Forest (Longleaf pine-turkey oak sandhill).

Acknowledgements

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## Ecological site concept

The Dry Sandy Upland Woodland (DSUW) ecological site is characterized by a longleaf pine overstory and wiregrass-dominated herbaceous layer. Two species of wiregrass occur across the area; *Aristida beyrichiana* occurs mostly in the southern portion with *A. stricta* found mostly north of the Santee River in South Carolina (Peet, 1993).

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Pinus palustris*<br>(2) *Quercus laevis* |
| Shrub | (1) *Vaccinium stamineum*<br>(2) *Gaylussacia dumosa* |
| Herbaceous | (1) *Aristida beyrichiana* |

## Legacy ID

F137XY070SC

## Physiographic features

The area is one of transition between the Southern Piedmont and Southern Coastal Plain. The majority of the area is located in the Sea Island Section of the Coastal Plain Province of the Atlantic Plain. The western part of the area in Georgia is located in the East Gulf Coastal Plain Section of the same province and division. Portions of the northern half of the MLRA are in the Piedmont Upland Section of the Piedmont Province of the Appalachian Highlands. The Dry Sandy Upland Woodland ecological site is presently correlated to only the portion of MLRA 137 that falls within the Sea Island Section. The area contained by the East Gulf Coastal Plain Section does not exhibit the same wiregrass understory found in the rest of the MLRA. The area is highly dissected and hilly, with elevations ranging from 165 to 660 feet. Local relief is typically 10 to 20 feet, but can range up to 165 feet.

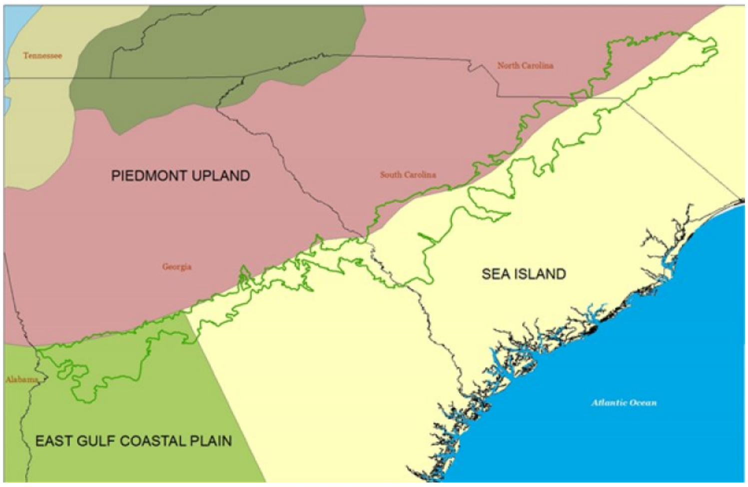


**Figure 2. Physiographic Sections of the Carolina and Georgia**

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Hill<br>(2) Interfluve<br>(3) Ridge |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 165–660 ft |
| Slope | 0–10% |
| Water table depth | 80 in |

| | |
|---|---|
| Aspect | Aspect is not a significant factor |

## Climatic features

The average annual precipitation in this area ranges from 41 to 53 inches (1,041 to 1,346 millimeters). Maxiumum precipitation occurs in midsummer, and the minimum occurs in autumn. High-intensity, convective thunderstorms account for summer rainfall. If snow occurs at all, it is in small amounts.

The average annual temperature ranges from 59 to 65 degrees F (15 to 18 degrees C).

Climate data is based on Normal PRISM data for the period 1981-2010. Seventeen stations were used to obtain average monthly minimum and maximum temperatures. Precipitation data is based on 24 climate stations across the MLRA. Minimum and maximum values are presented based on station averages for each month.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (average) | 250 days |
| Freeze-free period (average) | 275 days |
| Precipitation total (average) | 47 in |

## Climate stations used

- (1) HAMLET [USC00313784], Hamlet, NC
- (2) JACKSON SPRINGS 5 WNW [USC00314464], Jackson Springs, NC
- (3) JOHNSTON 4 SW [USC00384607], Johnston, SC
- (4) PAGELAND [USC00386616], Pageland, SC
- (5) AUGUSTA DANIEL FLD AP [USW00013837], Augusta, GA
- (6) AIKEN 5SE [USC00380074], Aiken, SC
- (7) CAMDEN 3 W [USC00381310], Camden, SC
- (8) SANDHILL RSCH ELGIN [USC00387666], Elgin, SC
- (9) BYRON EXP STN [USC00091448], Byron, GA
- (10) MACON MIDDLE GA RGNL AP [USW00003813], Macon, GA
- (11) AUGUSTA BUSH FLD AP [USW00003820], Augusta, GA
- (12) POPE AFB [USW00013714], Fort Bragg, NC
- (13) COLUMBIA [USW00013883], West Columbia, SC
- (14) WARNER ROBINS [USC00099124], Warner Robins, GA
- (15) CHERAW [USC00381588], Cheraw, SC
- (16) CHESTERFIELD 3 E [USC00381645], Chesterfield, SC
- (17) PELION 4 NW [USC00386775], Pelion, SC

## Influencing water features

Groundwater characteristics vary depending on the underlying geology throughout the area. Two types of aquifers occur in the area. The northern edge of the area has aquifers in the crystalline igneous and metamorphic rocks of the Southern Piedmont region. The southern edge has aquifers in the Cretaceous sediments of the Southern Coastal Plain. Soft water with very low amounts of total dissolved solids is a common characteristic of both aquifer types. The Cretaceous aquifer water is the sodium bicarbonate type, so the water is typically used for industry and public supply. The water from the crystalline rock aquifer contains calcium bicarbonate and supplies mostly domestic water needs.

No water features significantly influence this ecological site.

## Soil features

The site is represented by the components of the Alaga, Alpin, Candor, Lakeland, and Wakulla series. These soils are very deep, sandy, excessively or somewhat excessively drained soils formed mainly from eolian and marine sediments. The dominant representative slope for the correlated soil components is less than 6 percent. Map units with components correlated to this ecological site can range up to 10 percent slope, but the representative slope is less than six percent.

**Table 4. Representative soil features**

| | |
|---|---|
| Surface texture | (1) Sand<br>(2) Loamy sand<br>(3) Fine sand |
| Family particle size | (1) Loamy |
| Drainage class | Somewhat excessively drained to excessively drained |
| Permeability class | Moderate to rapid |
| Soil depth | 80 in |
| Surface fragment cover <=3" | 0% |
| Surface fragment cover >3" | 0% |
| Available water capacity (0-40in) | 1–7 in |
| Calcium carbonate equivalent (0-40in) | 0% |
| Electrical conductivity (0-40in) | 0 mmhos/cm |
| Sodium adsorption ratio (0-40in) | 0 |
| Soil reaction (1:1 water) (0-40in) | 4–6.5 |
| Subsurface fragment volume <=3" (Depth not specified) | 0–5% |
| Subsurface fragment volume >3" (Depth not specified) | 0% |

## Ecological dynamics

The Dry Sandy Upland Woodland site is composed of woodland vegetation with a canopy dominated by longleaf pine found on deep sands of dry uplands in the Carolina and Georgia Sand Hills (MLRA 137). These sites are prone to wildland fire. The natural fire regime, ignited by lightning, was probably as frequent as every few years (fire return interval = 2-3 years). Other fires were ignited by humans. Prior to the construction of roads, wildland fires may have burned extensively (thousands of acres). While most lightning in this area is associated with rain, lightning combined with high winds can start wildland fires. Today, prescribed fire can be used by land management agencies to restore and/or maintain the site.

The ecological dynamics of the Dry Sandy Upland Woodland are fire-dependent. There are two sources of fuel for the surface fires typical of the site. These are longleaf pine needles and the native herbaceous ground cover, especially native grasses such as wiregrass (*Aristida stricta* and *A. beyrichiana*). Naturally functioning sites need both fuel sources to adequately carry the frequent fires that are needed to maintain the site. The loss of either the longleaf pine trees or the native herbaceous ground cover can lead to less frequent surface fires, since fine fuels are reduced. Prolonged fire suppression alters the structure and composition of the site by driving succession toward hardwood dominated communities.

During the 19th century, longleaf pine declined as a result of turpentine extraction methods which damaged the trees and left them more susceptible to further damage from fire. Longleaf pine timber was coveted for its strength and durability, and many areas were nearly completely depleted of longleaf pine in the early 20th century (Frost and Langley, 2008). The timber industry moved on to other areas where large longleaf pine trees remained, continuing the cycle of tree loss. Longleaf pine is slower growing than loblolly and slash pine and will not regenerate as easily without fire. Many areas once native to longleaf pine became dominated by loblolly pine and hardwood trees as wildland fires were controlled in the middle of the 20th century. In recent decades land managers have become skilled at managing longleaf pine woodlands, and the value of longleaf pine forest products has gained more attention. The special qualities of longleaf pine woodlands are now recognized for their beauty and high biological diversity. Numerous rare plants and animals persist in the Dry Sandy Upland Woodland habitat, especially on the larger public lands, such as military installations and gamelands.

Restoration

Of the remaining areas of longleaf pine ecosystems, only about half are managed, leading to substantial alterations in ecosystem structure and composition (Outcalt, 2000). Pre-settlement fire regimes were typified by short fire-return intervals (FRI = 2–3 years), low-intensity surface fires ignited by lightning, and late Holocene Native Americans (Christensen, 1981). Fire suppression transforms these once open savanna–woodland ecosystems into closed canopy forests, with reduced floral and faunal species richness, as well as heavy accumulations of surface fuels. In some cases, changes from one state to another are reversible, but the return path is different from the path taken in the original change. Therefore, a thorough evaluation of reversibility is necessary before adopting a program of rehabilitation. For instance, a case study by Groffman and others (2006) revealed re-introduction of fire to areas that were suppressed was not effective in reversing the loss of longleaf pine because changes in the distribution of the vegetation lost the ability to transmit fire. Therefore more aggressive management of fire and competing vegetation may be required. General techniques and strategies for restoring upland ecosystems for longleaf pine related to this ecological site are discussed in the individual state and pathway narratives. On- site evaluations are required in order to develop specific recommendations and management prescriptions for desired states.

Prescribed fire is the most common management practice for restoring and maintaining longleaf pine ecosystems. The longleaf pine canopy and wiregrass in the understory function together as keystone species that facilitate but are resistant to fire (Platt et. al., 1988). Growing season burns, especially if frequent, can top kill and remove invading hardwoods effectively while winter fires are best suited for the reduction of hazardous fuels. Seasonality of fires will have varying results, depending on the desired outcome (i.e., vegetation control, seed bed preparation, wildlife forage, etc.) and the specific set of environmental conditions that govern the site.

Chemical control of vegetation, such as the selective application of herbicides, can accelerate the restoration process, especially where the ecosystem is degraded by oak invasion. For instance, low rates of hexazinone application have shown to be very effective in decreasing midstory hardwoods with little or no short-term reduction of understory grasses and forbs on sandhills sites (Brockway et. al., 1998). Other herbicides used in forest management include Velpar L and Pronone 10G. However, the rate of restoration can be significantly more rapid when chemical application is combined with prescribed burning (Boyer, 1991).

Mechanical drum shredders can control large mid-story vegetation. This is a recommended method to accomplish restoration of severely degraded longleaf pine forests. However, the use of mechanical control methods are often expensive, and their effectiveness can be short-lived because brush recovers rapidly in the region (Haywood et al., 2004). In addition, mechanical methods can destroy residual native ground cover propagules. If the management goal is to maintain intact native ground cover, other management options may be more suitable. In most instances, a combination of management practices is recommended in addition to the planting and monitoring of native vegetation.

State and Transition Model

A State and Transition Model for the Dry Sandy Upland Woodland Ecological Site (DSUW) follows this narrative. Thorough descriptions of each state, plant community phase, and transition and restoration pathways are found in the appropriate State narratives. This model is based on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.

Plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The reference plant community (state 1) is not necessarily the management goal. Because landowners have different management goals, the STM outlines methods used to transition to or restore a specific community. Biological processes on this site are complex. Therefore, representative values are presented in a land management context. The species lists are representative and are not complete botanical descriptions of all species occurring, or potentially occurring, on this site. The lists are not intended to cover the full range of botanical potential and site conditions or vegetative response to the conditions.

The following diagram suggests some pathways that the vegetation on this site might take. There may be other states not shown on the diagram. This information is intended to show what might happen in a given set of circumstances. It does not mean the pathway would proceed the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

## State and transition model

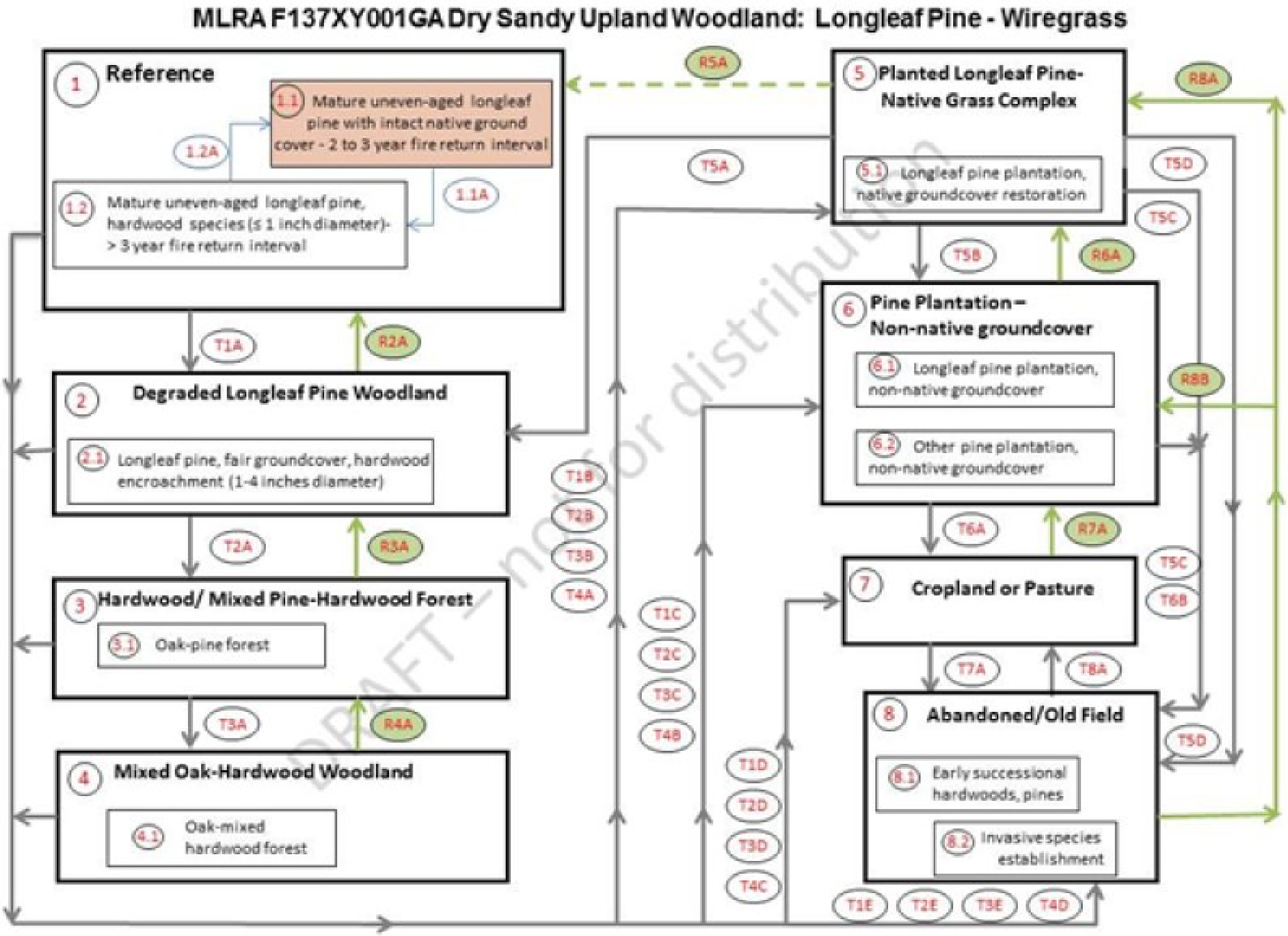


Figure 7. State and transition model (STM)

**1.1A**: Lack of fire (> 3 year fire return interval).

**1.2A**: Return to the 2-3 year fire frequency; hardwood removal or herbicide if needed.

**T1A, T2A, T3A, T5A**: Continued lack of fire or infrequent burning (> 3 year fire return interval)

**R2A**: Reintroduction of 2-3 year fire frequency, hardwood removal and/or herbicide if necessary.

**R3A, R4A**: Mechanical and chemical removal of hardwoods and unwanted pines (loblolly, slash), planting longleaf pine if necessary, reintroduction of 3-5 year fire return interval.

**T4A:** Hardwood removal (clear-cut, herbicide), longleaf establishment, native groundcover restoration if needed, reintroduction of 2-3 year fire frequency.

**T1B, T2B, T3B:** Clear cut, plant longleaf, re-establish native groundcover, 2-3 year fire frequency.

**T1C, T2C, T3C, T4B**: Clear cut and/or hardwood removal, plant pines (longleaf, loblolly, slash), 2-3 year fire frequency.

**T1D, T2D, T3D, T4C, T5C, T6A**: Clear-cut, stump and brush removal, establish crop or pasture.

**R5A:** This will require very long-term management (century-scale) in order to achieve an uneven-aged stand. This option is not viable for one generation to accomplish. In order to achieve the reference state, the stand must be managed to be uneven-aged.

**T5B:** Although it is not recommended to transition from a system that contains native ground cover, it is possible if tree density is too high and shades out the native heliophytic vegetation. If transitioning to community phase 6.1, native ground cover is lost. If transitioning to community phase 6.2, longleaf pine is removed, and native groundcover is lost.

**R6A:** If transitioning from phase 6.1, native groundcover restoration should occur: mechanical/chemical groundcover removal, site prep, establishment of native grasses. If transitioning from phase 6.2, longleaf pine needs to be established in addition to native groundcover establishment: other pine removal, site prep, tree establishment.

**R7A**: Site preparation, longleaf or other pine planting, and reintroduction of 2-3 year fire frequency.

**T1E, T2E, T3E, T4D, T5D, T6B, T7B**: Clear-cut, abandonment.

**R7B, R8B:** pH analysis since limed cropland/pastureland has higher pH, herbicide, potential scalping, subsoiling, tree establishment.

**Figure 8. Simplified STM legend.**

## State 1
## Reference State - Longleaf Pine/ Turkey Oak - Southern wiregrass upland

This is the historic climax plant community for this ecological site. An open canopy of longleaf pine exists with a minimal scrub oak understory, commonly turkey oak (*Quercus laevis*) with some bluejack oak ( *Q. incana*). Fire is the most important process in maintaining the natural vegetation of this ecological site. The amount of canopy closure in this community depends on the fire regime. Lack of fire tends to lead to the degradation of the natural vegetation by causing canopy closure by hardwoods and loss of longleaf pine and native grasses.

### Community 1.1
### Longleaf pine-wiregrass

**Figure 9. Fort Gordon, GA red-cockaded woodpecker site**

**Figure 10. Community Phase 1.1**

The overstory of this community is dominated by widely-spaced mature longleaf pine. Typical pine canopy cover ranges from 5 to 40 percent. Canopies are open and trees are uneven-aged but the community also includes variably-sized openings with even-aged trees. These openings result from windstorms, timber harvest, hot fires, or insect-induced mortality. For longleaf pine seed germination to occur, abundant light and bare soil are needed. These conditions are found in canopy gaps immediately following fire events. Common mid-story vegetation cover is generally sparse and composed mainly of oak species. Turkey oak (*Quercus laevis*) is the most common, followed by bluejack (*Q. incana*) and dwarf post oak (Q. margarettae). Some oaks can persist even though frequent fire discourages hardwood establishment. For most sites, a fire return interval of two to three years prevents hardwood invasion (Edwards et al., 2013). Species richness is high in the herbaceous understory of these communities (Peet and Allard, 1993). Wiregrass (Aristida species) is the dominant grass, but bluestems (Schizachrium and Andropogon species), and rosette grass (Dicanthelium sp.) can also be found. Georgia bear grass (*Nolina georgiana*), a rare species, is also found in dry longleaf pinelands (Sorrie, 2011). Grass-dominated groundcover provides necessary fine fuels for the spread of surface fires. Frequent low intensity fire is necessary for the perpetuation of this community phase.

**Forest overstory.** Pinus palustris (longleaf pine)

**Forest understory.** Quercus laevis (turkey oak)
Quercus incana (bluejack oak)
Quercus margarettae (dwarf post oak)
Diospyros virginiana (persimmon)
Sassafras albidum (sassafras)
Aristida beyrichiana (Beyrich threeawn)
Gaylusaccia dumosa (dwarf huckleberry)
Vaccinium stamineum (deerberry)
Tephrosia virginiana (Virginia tephrosia)
Baptisia perfoliata (catbells)

## Community 1.2
## Mature longleaf pine overstory, mid- and understory oak encroachment, in need of fire

**Figure 11. Longleaf pine with accelerating oak encroachment.**

This community phase is generally the result of lower fire frequency. Either fire suppression or a change in fire regime (burning every 3 to 5 years, dormant season burns) allows woody vegetation growth in the mid- and understory. Species composition is similar to phase 1.1. The dominant overstory species is longleaf pine, which are widely spaced across the landscape. Because of the buildup of litter and resulting lack of bare mineral soil, longleaf pine regeneration is inhibited. If fire suppression continues, oaks and other hardwoods will thrive, eventually out-competing any young longleaf that have managed to become established. In addition, herbaceous groundcover is not as abundant as in phase 1.1, although species composition is similar. Changes in fire regime result in successful hardwood encroachment, litter accumulation, and a subsequent shift in herbaceous species abundances.

**Forest overstory.** longleaf pine (Pinus palustris)
turkey oak (Quercus laevis)

## Pathway 1.1A
## Community 1.1 to 1.2

**Longleaf pine-wiregrass**

**Mature longleaf pine overstory, mid- and understory oak encroachment, in need of fire**

A fire frequency of two to three years controls encroaching hardwood trees and shrubs. Longleaf pine seed germination is promoted by eliminating thick litter layer development. Extended fire suppression or fire regime alteration will cause community phase 1.1 to transition to community phase 1.2. If the fire return interval persistently exceeds three years or fires occur during the dormant season, encroaching hardwoods will become well established. Longleaf pine seed germination will be severely inhibited due to litter accumulation and lack of bare soil.

## Pathway 1.2A
## Community 1.2 to 1.1

Mature longleaf pine overstory, mid- and understory oak encroachment, in need of fire

Longleaf pine-wiregrass

A return to a fire frequency of one to three years will revert community phase 1.2 to the reference community phase (1.1). This can be achieved by wildland fire or prescribed burning. In some areas, removal of hardwoods by mechanical or chemical means can speed up the restoration (Provencher et al., 2001; Brockway and Outcalt, 2000).

**Conservation practices**

| |
|---|
| Prescribed Burning |
| Restoration and Management of Rare and Declining Habitats |
| Forest Stand Improvement |
| Native Plant Community Restoration and Management |

## State 2
## Longleaf Pine - Oak Woodland

The longleaf pine-hardwood forest state is characterized by a more closed canopy relative to the reference state. Turkey oak (*Quercus laevis*) cover begins to rival longleaf pine. Less fire-tolerant pines such as loblolly pine (*Pinus taeda*) begin to establish. Hardwood trees such as dwarf post oak (Q. margarettae), bluejack oak ( *Q. incana*), and persimmon (*Diospyros virginiana*) compete with the remaining longleaf for canopy space. Shrub density and mass is increased relative to the reference state. Herbaceous species richness and productivity will continue to decline with canopy closure and the resulting decrease in sunlight penetration. Species richness is the number of different species present.

### Community 2.1
### Degraded longleaf pine with sparse regeneration, intermediate mid-story, and fair ground cover

**Figure 12. State 2**

More than five years of fire suppression crosses a threshold from state 1 to state 2. This state is characterized by scattered longleaf pine. Continued fire suppression allows turkey oak seedlings to reach basal diameters greater than four inches, which allows the hardwoods to resist surface fires that may occur. Thus, turkey oak cover begins to rival that of longleaf pine, and, due to lack of longleaf pine regeneration will become dominant. Loblolly pine (*Pinus taeda*) may also begin to encroach. Herbaceous species richness suffers from continued fire suppression. Increased shade negatively impacts native groundcover as hardwood coverage continues to expand. The result is degraded stand structure and reduction in fine fuels needed to carry a prescribed burn. This cycle continues to support hardwood dominance.

**Forest overstory.** Pinus palustris (longleaf pine)
Quercus laevis (turkey oak)
Quercus margarettae (dwarf post oak)
Quercus incana (bluejack oak)
Diospyros virginiana (persimmon)

## State 3
## Hardwood-Mixed Pine Forest

Lack of a favorable environment for regeneration and competition from hardwoods and other pines have resulted in either longleaf being lost from the site, or remaining individual trees being widely dispersed. Pines such as loblolly pine may have become established due to lack of fire. Canopy closure approaches 100 percent, dominated by oaks with some hickory, sweetgum, and persimmon. Because of lack of sunlight penetration to the understory, shrub size and numbers are reduced relative to state 2, and herbaceous species characteristic of the reference state are very sparse or no longer present.

### Community 3.1
### Mixed hardwood- Pine forest

**Figure 13. State 3, cropped image**


**Figure 14. State 3**

The canopy of this community phase is usually dominated by turkey oak ( *Quercus laevis*) and can have scattered loblolly pine (*Pinus taeda*). Longleaf can still be present, but regeneration is not occurring. Other oaks (*Q. incana*, Q. margarettae), persimmon (*Diospyros virginiana*), and sweetgum (*Liquidambar styraciflua*) are also present. The absence of fuels from pine needles and herbaceous plants will further decrease the ability of the site to carry surface fires and perpetuate the scrub oak-dominated forest.

**Forest overstory.** Pinus palustris (longleaf pine)
Pinus taeda (loblolly pine)
Quercus laevis (turkey oak)

**Forest understory.** Gaylussacia dumosa (dwarf huckleberry)
Vaccinium stamineum (deerberry)
Tephrosia virginiana (Virginia tephrosia)

## State 4
## Mixed Oak - Hardwood Forest

The Mixed Oak - Hardwood state is the product of long-term lack of fire management (century scale?). This community phase is naturally present in patches within the larger ecological site, most often on microsites that are protected from fire (Frost and Langley, 2008; Edwards et al., 2013). However, large-scale fire suppression allows continued encroachment of fire-tolerant oaks, and longleaf pine reproduction eventually ceases. This leaves the site open for continued scrub oak domination. Fine fuels typical for low intensity ground fires are absent, but coarser fuels such as branches and leaves are present. At Fort Gordon near Augusta, GA, this state has resulted from annual dormant season burns after hardwood establishment (Michale Juhan, personal communication). The timing and frequency of the prescribed fire have not been favorable for longleaf regeneration. Brockway and Outcalt (2000) suggest that presecribed fire alone is not effective at enhancing natural longleaf establishment after a major disturbance event such as wildfire. Hardwood removal (chemical or mechanical) in combination with prescribed fire is much more effective.

## Community 4.1
## Mixed oak - Hardwood Forest

**Figure 15. Turkey oak-dominated site at Fort Gordon in GA**

This could probably use some fleshing out... This community phase is naturally present in patches within the larger ecological site, most often on microsites that are protected from fire (Frost and Langley, 2008; Edwards et al., 2013). However, long-term fire suppression or lack of forest management can lead to larger spatial coverage of this state (Sorrie, 2011). After continued encroachment of fire-tolerant oaks, longleaf pine reproduction eventually ceases. This leaves the site open for continued scrub oak domination. Fine fuels needed to carry low intensity ground fires are absent, but coarser fuels such as branches and leaves are present.

**Forest overstory.** Quercus laevis (turkey oak)
Quercus incana (bluejack oak)
Pinus palustris (longleaf pine)
Pinus taeda (loblolly pine)
Sassafras albidum (sassafras)
Diospyros virginiana (persimmon)

**Forest understory.** Tephrosia virginiana (Virginia tephrosia)
Vaccinium stamineum (deerberry)

### State 5
### Planted Longleaf Pine with Native ground cover

Longleaf pine are planted to grow trees to a marketable size or to attempt to restore a system that would be similar to the reference plant community and in the interim sell pine straw as an urban landscape mulch (Alig et al., 2002). However, the richness of herbaceous species and associated animals are unlikely to completely mimic the reference state. However, this state is a functioning ecosystem with strong similarities to the reference plant community. Planted pines are generally even-aged and evenly spaced. If longleaf pine planting density is too high, the trees will shade out heliophytic native ground cover. In dense even-aged stands needle fall may be high, which can contribute to hotter fires. Consultation with a professional forester is recommended before establishing a longleaf pine plantation. Grasses commonly planted in this state are wiregrass, little bluestem, Indiangrass and switchgrass.

### Community 5.1
### Planted longleaf pine-native grasses

**Figure 16. State 5: Young longleaf plantation**

A shift to a planted longleaf pine - native grass state could be made from any other forested state in the ecological site by clear cutting, preparing the site and establishing pines and native ground cover (Fox et al., 2004). On former cropland, pasture or old field states, scalping and subsoiling will probably be necessary when preparing the site for tree planting. A planted longleaf pine - native grass state can be managed with fire and utilized as wildlife habitat or livestock grazing land. If shifted from a hardwood forest state, clear cut hardwood trees will sprout from the roots and will have to be controlled, usually with herbicides. If not controlled when the longleaf seedlings are young, hardwood trees and shrubs will likely overcome the site, overtopping and out- competing the longleaf seedlings for light. If shifted from a pine plantation state, a large variety of species could occur in the understory including trees, shrubs, vines, grasses, and grass-like species, forbs, and ferns. Supplemental planting of native understory species may or may not be needed depending on condition of the seed bank and the goals and objectives of the land manager. If pine species other than longleaf were originally established, the plantation can be shifted to longleaf either gradually with selective cutting, prescribed burning and longleaf seedling planting, or all at once with a clearcut, site prep and longleaf plantation establishment. If shifted from a pasture, cropland, or abandoned field state, the understory vegetation will likely be determined by the existing vegetation prior to tree planting and the field preparation that took place. If no permanent vegetation was present (i.e. crop field) then annual species will likely dominate the understory. If perennial grasses were present (i.e. pasture or abandoned field) then these grasses may return along with other annual species occasionally accompanied by greenbriar and blackberry. All understory species will start to diminish as the tree canopy closes unless thinning is utilized to manage for understory vegetation. More desirable native grasses and forbs will not be likely to appear from the seedbank if there is any history of cultivation. Supplemental planting will be necessary if native understory species restoration is a goal for the property. Planted longleaf pine - native grass states will need to be seeded or plugged to native warm season grasses such as wiregrass, little bluestem, and other native species that are commonly utilized as wildlife habitat. In these cases, tree canopy closure must be managed to allow for adequate light for understory vegetation to thrive.

### State 6
### Pine Plantation - Non-native ground cover

Loblolly and slash are the pine species most often planted in the region to produce a marketable wood product. Establishment of these pines has resulted in longleaf stands lacking native ground cover. Subsequent management will be in keeping with long-term and interim objectives and may include vegetation management with prescribed burning, and periodic stand thinning.

### Community 6.1
### Longleaf pine plantation with non-native groundcover

In recent years, longleaf pine planting has increased. However, not all tree planting is accompanied by native ground cover restoration. In the case of having non-native ground cover, the ecological functionality of the ecosystem does not mirror that of a complete longleaf pine-wiregrass ecosystem. Subsequent management should be planned with long term and interim objectives and may include vegetation management with prescribed burning and periodic stand thinning.

**Forest overstory.** Pinus palustris (longleaf pine)

### Community 6.2
### Loblolly or slash pine plantation

**Figure 17. State 6 - Loblolly pine plantation**

Southern pines can be managed in a variety of different ways and for a variety of different purposes including timber production, wildlife habitat, recreation, carbon sequestration, biomass production, pine straw production, silvopasture, or a combination of purposes. Pine plantations in this area are primarily managed for pulpwood or higher value products such as saw and veneer logs or utility poles. These products require using even-aged management that ultimately calls for clear-cutting and re-planting at the end of a specified rotation age. Precommercial thinning may occur as early as 5-10 years after stand establishment, and commercial thinning may occur at approximately 10 year intervals, usually producing pulpwood. Pine plantations usually undergo a final harvest between 25 and 45 years of age, but shorter rotation crops of 15 to 18 years are also considered. Silviculture practices include but are not limited to: site preparation, prescribed burning, tree planting, weed control, fertilization, and thinning (Alig et al., 2002). Alternative management prescriptions have been developed to allow for increased plant diversity, especially in the understory; improved wildlife habitat; and uneven-aged and mixed species overstories. Essentially these management prescriptions call for heavier thinning, more frequent prescribed burning and either planting or allowing natural regeneration of native grasses, forbs, shrubs and pine and/or hardwood trees. A proportion of the mature trees are allowed to reach much greater age than typical rotation ages for timber management purposes, creating greater variety of tree sizes and canopy structure. This state can be managed in a way to restore either the planted longleaf pine-native grass state (state 5) or the degraded longleaf pine woodland state (state 2). The pine plantation state can be maintained indefinitely unless a major disturbance such as a crown fire, inclement weather condition, pest, or disease contributes to eliminating the stand. Hardwood tree species will encroach after any thinning operation and must be controlled with prescribed fire, herbicides or a combination of both if a pure pine stand is desired.

**Forest overstory.** Pinus taeda
Pinus elliottii

### State 7
### Crop or Pasture land

If a pine plantation is not established, the most common agricultural use of the site is pasture or hay production. Fruit and vegetable production, and row crops can be regionally important. Agricultural yield information is available through Web Soil Survey (WSS) and can accessed here: http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

### State 8
### Abandoned/Old Field

When management or regular disturbances cease on cut-over forest, row crop or forage land, weedy and woody species become established. The abandoned field state is recognized by secondary plant community succession. Invasive species such as Chinese privet (*Ligustrum sinense*), silktree (Albiziz julibrissin), and cogon grass (*Imperata cylindrica*l) can invade and dominate southern pine sites and prevent many uses. Cogon grass is particularly difficult and costly to control.

### Transition T1A
### State 1 to 2

Continued infrequent or lack of fire will lead to a transition from state 1 to state 2. Increased hardwood and shrub development will occur, and these species will become more fire-tolerant as basal diameters increase. Lack of fire allows the accumulation of a thick litter layer, which inhibits longleaf pine seed germination. Lack of longleaf regeneration further enhances the success of hardwood species. The threshold from state 1 to state 2 is crossed when the natural fire frequency is removed for more than 5 years. Without persistent and costly management, reversal (restoring state 1) is extremely difficult (Walker and Silletti, 2006).

### Transition T1B
### State 1 to 5

Transition from state 1 to state 5: Clear cut, plant longleaf, re-establish native groundcover if necessary Although not recommended, it is possible to convert from state 1 to state 5. Site preparation should occur after an area is clear cut. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants; others kill grasses or legumes. Care should be taken when using herbicides to avoid unwanted disturbance and herbicide application to any remaining native ground cover. The site should be monitored for appearance of native groundcover. If herbaceous species do not naturally regenerate, the seed source may have been lost. Native groundcover should be established by planting. Selective cutting can perpetuate stand integrity while providing monetary gain to the landowner. Professional foresters should be consulted on this type of management goal.

### Transition T1C
### State 1 to 6

Transition from state 1 to state 6: Clear cut, plant pines (longleaf, loblolly, slash), maintain 2-3 year fire frequency Although not recommended, it is possible to convert from State 1 to State 6. Site preparation should occur after an area is clear cut. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes. Selective cutting can perpetuate stand integrity while providing monetary gain to the landowner. Professional foresters should be consulted on this type of management goal.

### Transition T1D
### State 1 to 7

Transition from State 1 to State 7: Clear-cut, stump and brush removal, establish crop or pasture

### Transition T1E
### State 1 to 8

Transition from State 1 to State 8: Although not recommended, it is possible to transition from the reference state to the Abandoned/Old Field State. This would occur upon clear-cutting and abandonment.

### Restoration pathway R2A
### State 2 to 1

Restoration from state 2 to state 1: Reintroduction of 2-3 year fire frequency, hardwood removal and/or herbicide if necessary A return to the 2-3 year fire frequency can restore state 2 to state 1. Longleaf forests accumulate high levels of litter due to the large size and decay resistance of the needles. Care should be exercised when re-introducing fire to this community. Fuel treatments such as raking and/or wetting the area around existing trees and mowing to remove standing fuels might be necessary to prevent mortality of the overstory. In some areas, removal of hardwoods by mechanical or chemical means can hasten restoration (Provencher et al., 2001; Brockway and Outcalt, 2000).

**Conservation practices**

| |
|---|
| Brush Management |
| Prescribed Burning |
| Restoration and Management of Rare and Declining Habitats |
| Forest Stand Improvement |

### Transition T2A
### State 2 to 3

Transition from state 2 to state 3: Continued lack of fire or infrequent burning Continued fire suppression (> 5 year fire return interval) can affect significant changes in vegetation structure and composition in this ecological site. Hardwood encroachment and establishment is outcompeting the remaining longleaf pine. Furthermore, natural regeneration of longleaf pine and the native herbaceous groundcover species is retarded.

### Transition T2B
### State 2 to 5

Transition from state 2 to state 5: Remove existing hardwoods (and pines if desired), plant longleaf, re-establish native groundcover if necessary, reintroduction of 2-3 year fire frequency After timber removal, site preparation should occur. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes. Care should be taken when using herbicides, as further disturbance and herbicide application can be detrimental to any remaining native ground cover. The site should be monitored for the appearance of native groundcover. If herbaceous species do not naturally regenerate, the seed source may have been lost. Native groundcover should be established by planting.

### Transition T2C
### State 2 to 6

Transition from state 2 to state 6: Clear cut (or hardwood removal), plant pines (longleaf, loblolly, slash), reintroduction of 2-3 year fire frequency After timber removal, site preparation should occur. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes. If transitioning to community phase 6.1, longleaf pine should be planted if necessary. If transitioning to community phase 6.2, other pine species should be planted.

### Transition T2D

## State 2 to 7

Transition from state 2 to state 7: Clear-cut, stump and brush removal, establish crop or pasture

## Transition T2E
## State 2 to 8

Transition from state 2 to state 8: Although not recommended, it is possible to transition from this state to the Abandoned/Old field state. This would occur upon clear-cutting and abandonment.

## Restoration pathway R3A
## State 3 to 2

Restoration from state 3 to state 2: Mechanical and chemical removal of hardwoods and unwanted pines (loblolly, slash), planting longleaf pine if necessary, reintroduction of 3-5 year fire return interval. Longleaf forests accumulate high levels of litter because needles are large and decay resistant. High residual fuel loads may be present where longleaf pine occur. If desired longleaf pine trees are still present on the site, care should be exercised when re-introducing fire to this community. Fuel treatments such as raking and/or wetting the area around existing trees and mowing to remove standing fuels might be necessary to prevent mortality of the overstory. Site preparation is important after timber removal. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes. Care should be taken when using herbicides to avoid unwanted disturbance and herbicide application to any remaining native ground cover. The site should be monitored for the appearance of native grasses. If herbaceous species do not naturally regenerate, the seed source may have been lost. If native grasses must be planted becuase no seed source is present, the system cannot be restored to state 2, but will resemble the functioning ecosystem of state 5.

**Conservation practices**

| |
|---|
| Brush Management |
| Prescribed Burning |
| Tree/Shrub Site Preparation |
| Tree/Shrub Establishment |
| Restoration and Management of Rare and Declining Habitats |
| Forest Stand Improvement |

## Transition T3A
## State 3 to 4

Transition from state 3 to state 4: Continued lack of fire or infrequent burning Continued fire suppression results in further significant changes in vegetation structure and composition in this ecological site. Hardwood species, particularly scrub oaks, now dominate the forest mid-story, and herbaceous ground cover is largely absent. This community is unable to carry low intensity fires without drastic chemical or mechanical treatments, or catastrophic fires.

## Transition T3B
## State 3 to 5

Transition from state 3 to state 5: Remove oaks and other hardwoods, plant longleaf, re-establish native groundcover if necessary, reintroduction of 2-3 year fire frequency After timber removal, site preparation should occur. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes. Care should be taken when using herbicides to avoid unwanted disturbance and herbicide application to any remaining native ground cover. The site should be monitored for the appearance of native groundcover. If herbaceous species do not naturally regenerate, the seed source may have been lost. Native groundcover should be established by planting.

### Transition T3C
### State 3 to 6

Transition from state 3 to state 6: Clear cut (or hardwood removal), plant pines (longleaf, loblolly, slash), re-establish native groundcover if necessary, reintroduction of 2-3 year fire frequency After timber removal, site preparation should occur. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes.

### Transition T3D
### State 3 to 7

Transition from state 3 to state 7: Clear-cut, stump and brush removal, establish crop or pasture

### Transition T3E
### State 3 to 8

Transition from state 3 to state 8: Although not recommended, it is possible to transition from this state to the Abandoned/Old field State. This would occur upon clear-cutting and abandonment.

### Restoration pathway R4A
### State 4 to 3

Restoration from state 4 to state 3: Mechanical and chemical removal of hardwoods, establishment of pines if necessary, reintroduction of 3-5 year fire return interval. Site preparation is important after timber removal. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes. Care should be taken when using herbicides, as disturbance and herbicide application can be detrimental to any remaining native ground cover. The site should be monitored for the appearance of native groundcover. If herbaceous species do not naturally regenerate, the seed source may have been lost. Native groundcover should be established by planting.

#### Conservation practices

| |
|---|
| Brush Management |
| Prescribed Burning |
| Tree/Shrub Site Preparation |
| Tree/Shrub Establishment |
| Restoration and Management of Rare and Declining Habitats |
| Forest Stand Improvement |

### Transition T4A
### State 4 to 5

Transition from state 4 to state 5: Hardwood removal (clear-cut, herbicide), longleaf establishment, native groundcover restoration if needed, reintroduction of 2-3 year fire frequency Site preparation is important after timber removal. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes. Care should be taken when using herbicides, as disturbance and herbicide application can be detrimental to any remaining native ground cover.

### Transition T4B
### State 4 to 6

Transition from state 4 to state 6: Hardwood removal (clear-cut, herbicide), plant pines (longleaf, loblolly, slash), reintroduction of 2-3 year fire frequency After timber removal, site preparation should occur. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes.

### Transition T4C
### State 4 to 7

Transition from state 4 to state 7: Clear-cut, stump and brush removal, establish crop or pasture

### Transition T4D
### State 4 to 8

Transition from state 4 to state 8: Clear cut and abandonment or lack of management

### Restoration pathway R5A
### State 5 to 1

Restoration from state 5 to state 1: This will require very long-term management (century-scale) in order to achieve an uneven-aged stand. This option is not viable for one generation of ownership to accomplish. In order to achieve the reference state, the stand must be managed to be uneven-aged.

#### Conservation practices

| |
|---|
| Prescribed Burning |
| Restoration and Management of Rare and Declining Habitats |
| Forest Stand Improvement |

### Transition T5A
### State 5 to 2

Transition from state 5 to state 2: Lack of fire (fire return interval > 3 years) Fire suppression can significantly change the vegetation structure and composition of this ecological site. Hardwood encroachment results from fire suppression. Furthermore, natural regeneration of longleaf pine and the native herbaceous groundcover species is retarded as fuels build up. However, this transition would be different in that state 2 describes natural longleaf stands. The transition from a planted stand would have different age structure, but the trigger (lack of fire) would be the same. This would cause the result to be most like state 2 except the pines would be even-aged.

### Transition T5B
### State 5 to 6

Transition from state 5 to state 6: Although it is not recommended to transition from a system that contains native ground cover, it is possible if tree density is too high and shades out the native heliophytic vegetation. If transitioning to community phase 6.1, native ground cover is lost. If transitioning to community phase 6.2, longleaf pine is removed, and native groundcover is lost.

### Transition T5C
### State 5 to 7

Transition from state 5 to state 7: Clear-cut, stump and brush removal, crop/pasture establishment

### Transition T5D
### State 5 to 8

Transition from state 5 to state 8: Clear-cut, abandonment

### Restoration pathway R6A
### State 6 to 5

Restoration from state 6 to state 5: If transitioning from phase 6.1, native ground cover restoration should occur. If transitioning from phase 6.2, longleaf pine needs to be established in addition to native ground cover establishment. This requires removal of other pine species. Site preparation should occur after timber removal. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicides target woody plants, while others kill grasses or legumes. Care should be taken when using herbicides to avoid unwanted disturbance and herbicide application to any remaining native ground cover.

#### Conservation practices

| |
|---|
| Brush Management |
| Prescribed Burning |
| Tree/Shrub Site Preparation |
| Tree/Shrub Establishment |
| Restoration and Management of Rare and Declining Habitats |
| Forest Stand Improvement |

### Transition T6A
### State 6 to 7

Transition from state 6 to state 7: Clear-cut, stump and brush removal, crop/pasture establishment

### Transition T6B
### State 6 to 8

Transition from State 6 to State 8: Clear-cut, abandonment

### Restoration pathway R7B
### State 7 to 5

Restoration from State 7 to State 5: Assess site suitability (pH requirements for longleaf pine), specific site preparation (scalping, subsoiling), plant longleaf pine, establish native groundcover This restoration pathway requires specific management. First, many agricultural fields and pastures have received lime applications, which, over time have increased the pH of the soil. It is difficult to successfully establish longleaf pine on sites with a pH higher than 7.0. If pH is not an issue, the pasture grasses and agricultural weed complex will be. Aggressive control of these herbaceous species can be achieved using appropriate herbicides. A technique called scalping has also proved to be beneficial on agricultural lands, particularly pastures. Scalping essentially forms a shallow (2-4”) but wide (30-36”) furrow by peeling the soil back. Scalping is not recommended for wet areas or soils with high clay content because the scalped rows may hold too much water and drown the seedlings. Highly compacted crop land may require sub-soiling prior to planting to break up any overly compacted soil that will inhibit seedling establishment.

**Conservation practices**

| |
|---|
| Prescribed Burning |
| Firebreak |
| Tree/Shrub Site Preparation |
| Tree/Shrub Establishment |
| Restoration and Management of Rare and Declining Habitats |
| Forest Stand Improvement |

## Restoration pathway R7A
## State 7 to 6

Restoration from State 7 to State 6: Site preparation, longleaf or other pine planting, and reintroduction of 2-3 year fire frequency This restoration pathway requires specific management. First, many agricultural fields and pastures have received lime applications, which, over time have increased the pH of the soil. It is difficult to successfully establish longleaf pine on sites with a pH higher than 7.0. If pH is not an issue, the pasture grasses and agricultural weed complex will be. Aggressive control of these herbaceous species can be achieved using appropriate herbicides. A technique called scalping has also proved to be beneficial on agricultural lands, particularly pastures. Scalping essentially forms a shallow (2-4”) but wide (30-36”) furrow by peeling the soil back. Scalping is not recommended for wet areas or soils with high clay content because the scalped rows may hold too much water and drown the seedlings. Highly compacted crop land may require sub-soiling prior to planting to break up any overly compacted soil that will inhibit seedling establishment.

**Conservation practices**

| |
|---|
| Brush Management |
| Prescribed Burning |
| Firebreak |
| Tree/Shrub Site Preparation |
| Restoration and Management of Rare and Declining Habitats |
| Forest Stand Improvement |
| Transition from Irrigation to Dry-land Plan - Applied |

## Transition T7A
## State 7 to 8

Transition from State 7 to State 8: Clear-cut, abandonment

## Restoration pathway R8A
## State 8 to 5

Restoration from State 8 to State 5: Longleaf pine establishment and native groundcover restoration should occur. This requires removal of other pine species. After timber removal, site preparation should occur. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicide target woody plants, while others kill grasses or legumes. Care should be taken when using herbicides, as further disturbance and herbicide application can be detrimental to any remaining native ground cover.

**Conservation practices**

| |
|---|
| Brush Management |
| Prescribed Burning |
| Firebreak |
| Tree/Shrub Site Preparation |
| Tree/Shrub Establishment |
| Restoration and Management of Rare and Declining Habitats |
| Forest Stand Improvement |

## Restoration pathway R8B
## State 8 to 6

Restoration from State 8 to State 6: Land must be cleared, brush removed, and pines established This requires removal of hardwood and other undesirable species. After timber removal, site preparation should occur. Coarse woody debris can impede tree planters. Concentrating debris in windrows and piles and burning it is recommended. Unwanted vegetation should be controlled prior to planting to reduce competition for the new stand. This can be accomplished by mechanical and/or chemical methods. Herbicide prescriptions can be developed to target specific species or groups of unwanted vegetation. For example, some herbicide target woody plants, while others kill grasses or legumes. Care should be taken when using herbicides, as further disturbance and herbicide application can be detrimental to any remaining native ground cover.

**Conservation practices**

| |
|---|
| Brush Management |
| Prescribed Burning |
| Firebreak |
| Tree/Shrub Site Preparation |
| Tree/Shrub Establishment |

## Transition T8A
## State 8 to 7

Transition from State 8 to State 7: Land should be cleared and stumped, and crop or pasture established

## Additional community tables

**Table 5. Community 1.1 forest overstory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) | Diameter (In) | Basal Area (Square Ft/Acre) |
|---|---|---|---|---|---|---|---|
| **Tree** | | | | | | | |
| longleaf pine | PIPA2 | *Pinus palustris* | Native | – | 5–40 | 18–48 | – |

**Table 6. Community 1.1 forest understory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) |
|---|---|---|---|---|---|
| **Grass/grass-like (Graminoids)** | | | | | |
| Beyrich threeawn | ARBE7 | *Aristida beyrichiana* | Native | – | 15–40 |
| pineland threeawn | ARST5 | *Aristida stricta* | Native | – | 3.5–40 |
| purple bluestem | ANGL10 | *Andropogon glaucopsis* | Native | – | 0.5–2 |
| capillary hairsedge | BUCIC | *Bulbostylis ciliatifolia var. coarctata* | Native | – | 0.5–2 |

| | | | | | |
|---|---|---|---|---|---|
| pineywoods dropseed | SPJU | *Sporobolus junceus* | Native | – | 0.1–0.5 |
| Gray's beaksedge | RHGR2 | *Rhynchospora grayi* | Native | – | 0.1–0.5 |
| Addison's rosette grass | DIOVA | *Dichanthelium ovale var. addisonii* | Native | – | 0.1–0.5 |
| blood panicgrass | DICO4 | *Dichanthelium consanguineum* | Native | – | 0.1–0.5 |
| **Forb/Herb** | | | | | |
| catbells | BAPE3 | *Baptisia perfoliata* | Native | – | 0.5–3 |
| combleaf yellow false foxglove | AUPE | *Aureolaria pectinata* | Native | – | 0.5–2 |
| Virginia groundcherry | PHVIV3 | *Physalis virginiana var. virginiana* | Native | – | 0.5–2 |
| narrowleaf silkgrass | PIGR4 | *Pityopsis graminifolia* | Native | – | 0.1–2 |
| anisescented goldenrod | SOODO | *Solidago odora var. odora* | Native | – | 0.5–2 |
| Atlantic poison oak | TOPU2 | *Toxicodendron pubescens* | Native | – | 0.5–2 |
| pine barren stitchwort | MICA8 | *Minuartia caroliniana* | Native | – | 0.5–2 |
| Carolina indigo | INCA | *Indigofera caroliniana* | Native | – | 0.5–2 |
| hairy lespedeza | LEHI2 | *Lespedeza hirta* | Native | – | 0.5–2 |
| pineland pinweed | LESE7 | *Lechea sessiliflora* | Native | – | 0.5–2 |
| waxy thoroughwort | EUGL7 | *Eupatorium glaucescens* | Native | – | 0.5–2 |
| Virginia tephrosia | TEVI | *Tephrosia virginiana* | Native | – | 0.5–1.5 |
| grassleaf lettuce | LAGRG | *Lactuca graminifolia var. graminifolia* | Native | – | 0.1–1 |
| orangegrass | HYGE | *Hypericum gentianoides* | Native | – | 0.1–1 |
| slenderstalk beeblossom | GAFI2 | *Gaura filipes* | Native | – | 0.1–1 |
| cottony goldenaster | CHGOG | *Chrysopsis gossypina ssp. gossypina* | Native | – | 0.1–1 |
| kidneyleaf rosinweed | SICO5 | *Silphium compositum* | Native | – | 0.1–0.5 |
| butterfly milkweed | ASTU | *Asclepias tuberosa* | Native | – | 0.1–0.5 |
| grayhairy wild indigo | BACI | *Baptisia cinerea* | Native | – | 0.1–0.5 |
| sandywoods chaffhead | CABE4 | *Carphephorus bellidifolius* | Native | – | 0.1–0.5 |
| tall ironweed | VEAN | *Vernonia angustifolia* | Native | – | 0.1–0.5 |
| sandhill thistle | CIRE2 | *Cirsium repandum* | Native | – | 0.1–0.5 |
| finger rot | CNURS | *Cnidoscolus urens var. stimulosus* | Native | – | 0.1–0.5 |
| pine barren stitchwort | MICA8 | *Minuartia caroliniana* | Native | – | 0.1–0.5 |
| coastal plain dawnflower | STPA8 | *Stylisma patens* | Native | – | 0.1–0.5 |
| pineland scalypink | STSES | *Stipulicida setacea var. setacea* | Native | – | 0.1–0.5 |
| wavyleaf noseburn | TRUR | *Tragia urens* | Native | – | 0.1–0.5 |
| eastern milkpea | GARE2 | *Galactia regularis* | Native | – | 0.1–0.5 |
| cottony goldenaster | CHGOG | *Chrysopsis gossypina ssp. gossypina* | Native | – | 0–0.1 |
| **Shrub/Subshrub** | | | | | |
| dwarf huckleberry | GADU | *Gaylussacia dumosa* | Native | – | 0.5–17.5 |
| deerberry | VAST | *Vaccinium stamineum* | Native | – | 3.5–7.5 |
| Georgia beargrass | NOGE | *Nolina georgiana* | Native | – | 1.5–3 |
| St. Andrew's cross | HYHY | *Hypericum hypericoides* | Native | – | 0.1–2 |
| St. Andrew's cross | HYHY | *Hypericum hypericoides* | Native | – | 0.1–0.5 |
| farkleberry | VAAR | *Vaccinium arboreum* | Native | – | 0.1–0.5 |
| **Tree** | | | | | |
| turkey oak | QULA2 | *Quercus laevis* | Native | – | 5–20 |

| | | | | | |
|---|---|---|---|---|---|
| sassafras | SAAL5 | *Sassafras albidum* | Native | – | 0.1–5 |
| bluejack oak | QUIN | *Quercus incana* | Native | – | 0.1–5 |
| violet crabgrass | DIVI2 | *Digitaria violascens* | Native | – | 1.5–4 |
| common persimmon | DIVI5 | *Diospyros virginiana* | Native | – | 0.1–3.5 |
| **Vine/Liana** | | | | | |
| evening trumpetflower | GESE | *Gelsemium sempervirens* | Native | – | 0.5–2 |

**Table 7. Community 1.2 forest overstory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) | Diameter (In) | Basal Area (Square Ft/Acre) |
|---|---|---|---|---|---|---|---|
| **Tree** | | | | | | | |
| longleaf pine | PIPA2 | *Pinus palustris* | Native | – | 5–35 | – | – |
| turkey oak | QULA2 | *Quercus laevis* | Native | – | 15–35 | – | – |

**Table 8. Community 1.2 forest understory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) |
|---|---|---|---|---|---|
| **Grass/grass-like (Graminoids)** | | | | | |
| pineland threeawn | ARST5 | *Aristida stricta* | Native | – | 5–20 |
| pineywoods dropseed | SPJU | *Sporobolus junceus* | Native | – | 0.1–0.5 |
| Gray's beaksedge | RHGR2 | *Rhynchospora grayi* | Native | – | 0.1–0.5 |
| Addison's rosette grass | DIOVA | *Dichanthelium ovale var. addisonii* | Native | – | 0.1–0.5 |
| dwarf huckleberry | GADU | *Gaylussacia dumosa* | Native | – | 0.1–0.5 |
| **Forb/Herb** | | | | | |
| pine barren stitchwort | MICA8 | *Minuartia caroliniana* | Native | – | 0.1–0.5 |
| St. Andrew's cross | HYHY | *Hypericum hypericoides* | Native | – | 0.1–0.5 |
| grayhairy wild indigo | BACI | *Baptisia cinerea* | Native | – | 0.1–0.5 |
| coastal plain dawnflower | STPAP8 | *Stylisma patens ssp. patens* | Native | – | 0.1–0.5 |
| wavyleaf noseburn | TRUR | *Tragia urens* | Native | – | 0.1–0.5 |
| tall ironweed | VEAN | *Vernonia angustifolia* | Native | – | 0.1–0.5 |
| kidneyleaf rosinweed | SICO5 | *Silphium compositum* | Native | – | 0.1–0.5 |
| anisescented goldenrod | SOODO | *Solidago odora var. odora* | Native | – | 0.1–0.5 |
| narrowleaf silkgrass | PIGR4 | *Pityopsis graminifolia* | Native | – | 0.1–0.5 |
| dwarf huckleberry | GADU | *Gaylussacia dumosa* | Native | – | 0.1–0.5 |
| capillary hairsedge | BUCIC | *Bulbostylis ciliatifolia var. coarctata* | Native | – | 0.1–0.5 |
| **Shrub/Subshrub** | | | | | |
| Atlantic poison oak | TOPU2 | *Toxicodendron pubescens* | Native | – | 0.1–0.5 |
| **Tree** | | | | | |
| turkey oak | QULA2 | *Quercus laevis* | Native | 1–10 | 5–15 |
| bluejack oak | QUIN | *Quercus incana* | Native | – | 1–5 |
| sassafras | SAAL5 | *Sassafras albidum* | Native | – | 0–5 |
| common persimmon | DIVI5 | *Diospyros virginiana* | Native | – | 0.5–5 |
| bluejack oak | QUIN | *Quercus incana* | Native | – | 0.1–3.5 |

**Table 9. Community 2.1 forest overstory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) | Diameter (In) | Basal Area (Square Ft/Acre) |
|---|---|---|---|---|---|---|---|
| **Tree** | | | | | | | |
| turkey oak | QULA2 | *Quercus laevis* | Native | – | 20–40 | – | – |
| longleaf pine | PIPA2 | *Pinus palustris* | Native | – | 5–20 | – | – |
| bluejack oak | QUIN | *Quercus incana* | Native | – | 0–5 | – | – |
| common persimmon | DIVI5 | *Diospyros virginiana* | Native | – | 0–3 | – | – |

**Table 10. Community 3.1 forest overstory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) | Diameter (In) | Basal Area (Square Ft/Acre) |
|---|---|---|---|---|---|---|---|
| **Tree** | | | | | | | |
| turkey oak | QULA2 | *Quercus laevis* | Native | – | 20–50 | – | – |
| loblolly pine | PITA | *Pinus taeda* | Native | – | 5–20 | – | – |
| longleaf pine | PIPA2 | *Pinus palustris* | Native | – | 1–20 | – | – |

**Table 11. Community 3.1 forest understory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) |
|---|---|---|---|---|---|
| **Forb/Herb** | | | | | |
| Virginia tephrosia | TEVI | *Tephrosia virginiana* | Native | – | 0–5 |
| **Shrub/Subshrub** | | | | | |
| deerberry | VAST | *Vaccinium stamineum* | – | – | 1–10 |
| dwarf huckleberry | GADU | *Gaylussacia dumosa* | Native | – | 0.5–10 |

**Table 12. Community 4.1 forest overstory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) | Diameter (In) | Basal Area (Square Ft/Acre) |
|---|---|---|---|---|---|---|---|
| **Tree** | | | | | | | |
| turkey oak | QULA2 | *Quercus laevis* | Native | – | 20–40 | – | – |
| loblolly pine | PITA | *Pinus taeda* | Native | – | 0–10 | – | – |
| bluejack oak | QUIN | *Quercus incana* | Native | – | 1–5 | – | – |
| longleaf pine | PIPA2 | *Pinus palustris* | Native | – | 0–5 | – | – |
| common persimmon | DIVI5 | *Diospyros virginiana* | Native | – | 0.5–3 | – | – |
| sassafras | SAAL5 | *Sassafras albidum* | Native | – | 0.5–3 | – | – |

**Table 13. Community 4.1 forest understory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (Ft) | Canopy Cover (%) |
|---|---|---|---|---|---|
| **Forb/Herb** | | | | | |
| Virginia tephrosia | TEVI | *Tephrosia virginiana* | Native | – | 1–3 |
| **Shrub/Subshrub** | | | | | |
| deerberry | VAST | *Vaccinium stamineum* | Native | – | 1–5 |

## Animal community

Because the sandy soils have high infiltration rates, the fauna of the area must process water efficiently, as desert species do. For example, amphibians lay their eggs in the deepest pools they can find, which are associated with areas of higher clay content.

The animals associated with this ecological site are adapted to the historical fire regime. Red-cockaded woodpeckers bore nesting cavities in live trees and forage in a relatively open understory. The deep sands of the Sand Hills provide suitable habitat for the gopher tortoise even though it is generally associated with the flatter Southern Coastal Plain. Bachman""s sparrows nest and feed on the ground but must move to different sites if the grasses and shrubs become too dense from lack of fire. Fox squirrels feed primarily on longleaf pine nuts and typically live in the upper canopy where flames don""t reach. Pine snakes use stump holes as protection from heat and flames.

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### 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 | |
| Approved by | |
| 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:**