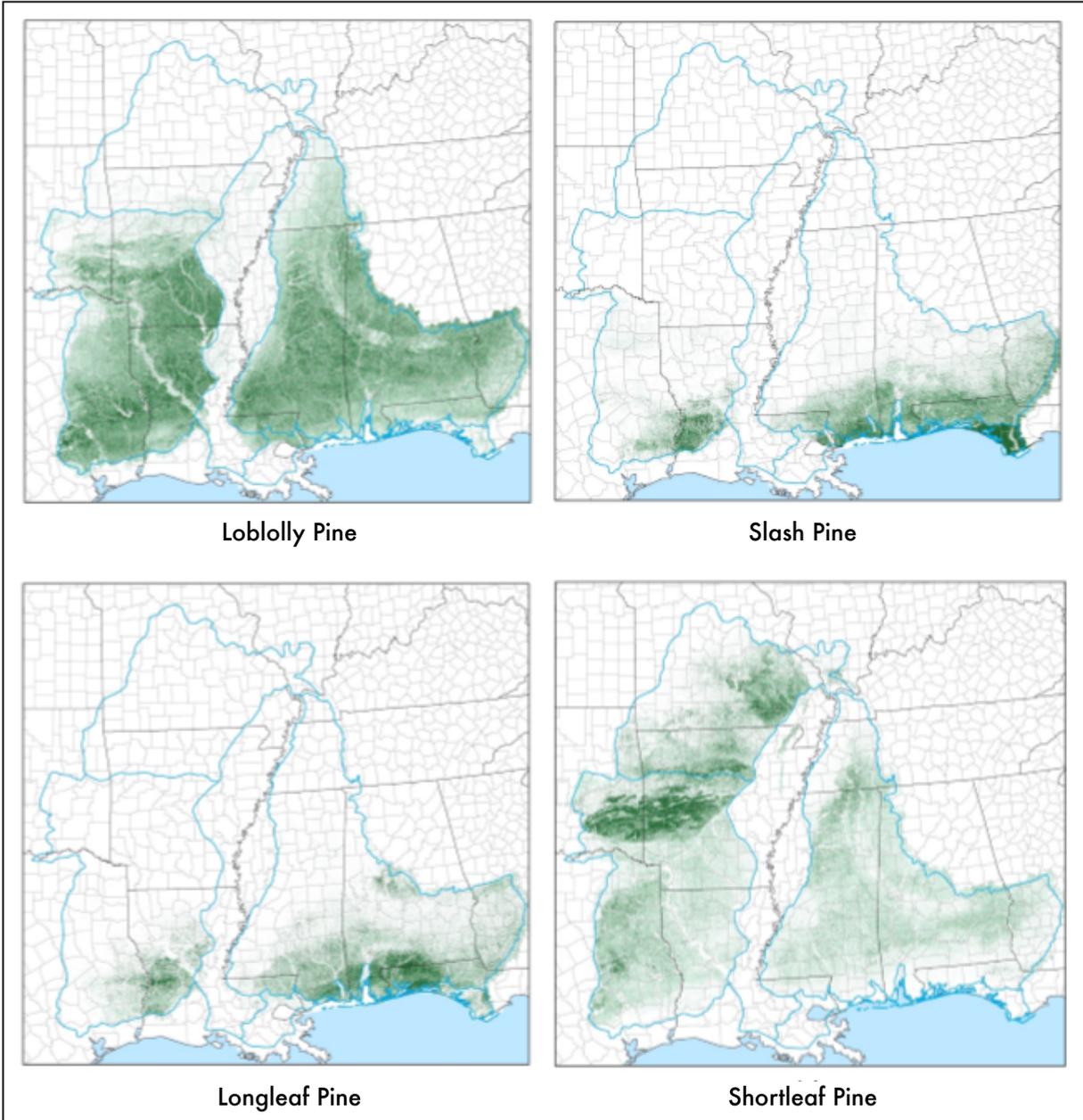


DRAFT Open Pine/Savanna in the East and West Gulf Coastal Plain (EWGCP)



From the Executive Summary
of the 2016 State of the GCPO

PHOTOS, CITATION, ACKNOWLEDGEMENTS

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Live tree basal area values for 4 pine species in the GCPO - Toby Gray, GIS Analyst, GCPO LCC

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The objectives of this open pine and woodland rapid ecological assessment are to provide information about (1) how much and where the pine-dominated landscapes in the GCPO meet the criteria for open pine habitat as defined in the [Integrated Science Agenda](#) (ISA), (2) how much more such habitat is needed, and (3) where opportunities exist to manage for these conditions (through thinning, burning, reforestation, enhancement, etc.). The ISA defines the desired ecological state for open pine as “woodlands and savannas that are floristically rich and comprised mostly of site-appropriate pine with low basal area, open canopies, and dense herbaceous understories in large interconnected blocks.”



Open canopy of a mature longleaf pine stand - Taylor Hannah, GCPO LCC

Open pine as a priority ecological system is an evolving scientific concept, defined as much by its structure as by its species. Open pine is one of the most beautiful forms of southern pine forests, known for its open structure -- maintained by fire or other disturbance -- that allows dappled sunlight to support a diversity of grasses and flowers in the understory as well as a suite of open pine-dependent wildlife species. Historically, both lightning strikes and management by Native Americans were integral to maintaining the characteristically open structure of these forests. Removal of the original trees during the time of settlement combined with decades of fire suppression have resulted in the dense, closed structure of many southern pine forests today.



Within the East and West Gulf Coastal Plains (EWGCP) of the GCPO region, pine dominant systems are widespread, but open pine communities that meet some or all of the ISA criteria are much less common. Assessing open pine required a two step process of first identifying the extent of pine-dominant systems (shown in Figure 1), then identifying where within those systems the ISA landscape endpoints that describe open pine occur. These endpoints include target ranges for basal area, diameter at breast height (DBH), canopy cover, midstory shrub and hardwood cover, herbaceous understory, patch size, patch connectivity, and distribution of successional stages.

Figure 1: Map of pine-dominant ecological systems in the GCPO created by selecting appropriate ecological system and land use classes from the [National GAP Land Cover Data](#) layer.

Summary of Findings for Landscape Endpoints

AMOUNT

Acreage of Pine-Dominant Ecological Systems

Figure 1 shows the extent of pine-dominant systems in the GCPO -- regardless of condition or configuration -- by using National GAP Land Cover data. Results indicate a total of 45,441,680 acres of pine-dominant ecological system and land-use classes covering about 25% of the entire region, and covering about 42% and 34% of the West and the East Gulf Coastal Plains, respectively (see Table 1 for acreage estimates). More than 95% of all pine-dominant lands are found in the East and West Gulf Coastal Plains (EWGCP). They are sparse in the alluvial plains of big rivers and in plains regions where agriculture predominates. See the last section on *Amount and Configuration of Open Pine* for estimates of the open pine condition, which represents a subset of this acreage.

CONDITION

Basal area of 40-70 square feet per acre

Virtually all open pine restoration prescriptions involve reducing the number of trees and maintaining stands at some threshold density or basal area below that which occurs in the absence of disturbance. The ISA specifies a desired landscape endpoint for basal area



Low basal area in a stand of open pine, Grand Bay National Estuarine Research Reserve - Taylor Hannah, GCPO LCC

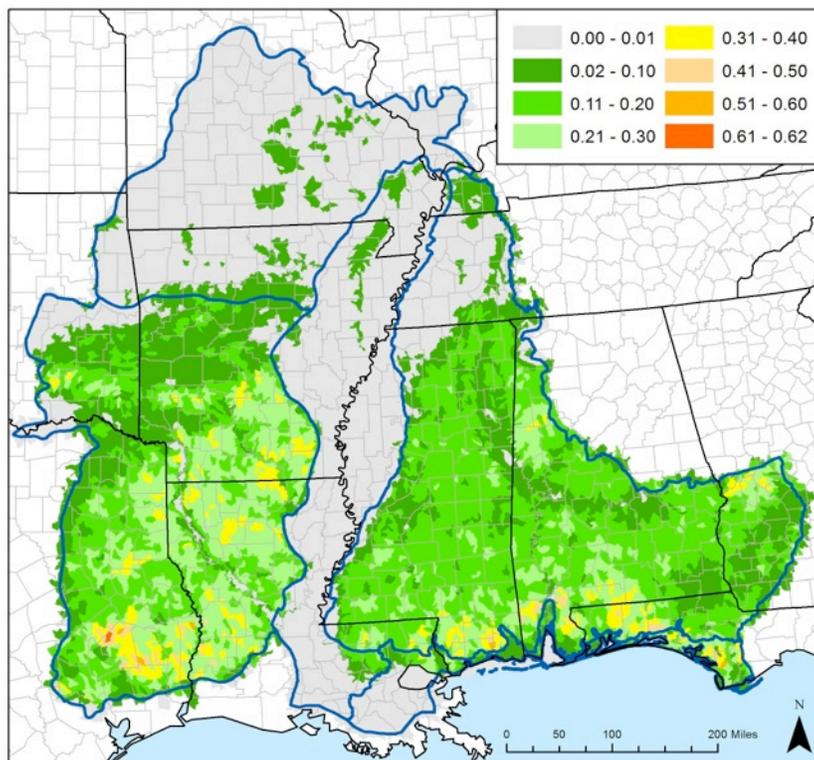


Figure 2. Proportion of watershed (HUC12) area with pine-dominant basal area values within the desired range of 40-70 ft²/acre

of 40 – 70 ft²/acre. Available data allowed only the assessment of this endpoint for all tree species, not solely pine, within pine dominant forests. The assessment indicates that 16.3 million acres, or 38%, of pine-dominant systems in the EWGCP meet the target (see Figure 2; see Table 1 for acreage estimates). The desired endpoint occurs throughout the EWGCP, with highest concentrations in southeastern Texas, southern Mississippi and Alabama, northwestern Florida, and central Georgia. However, some known open pine locations indicate wildlife use of open pine with basal area less than the 40 ft²/acre threshold.

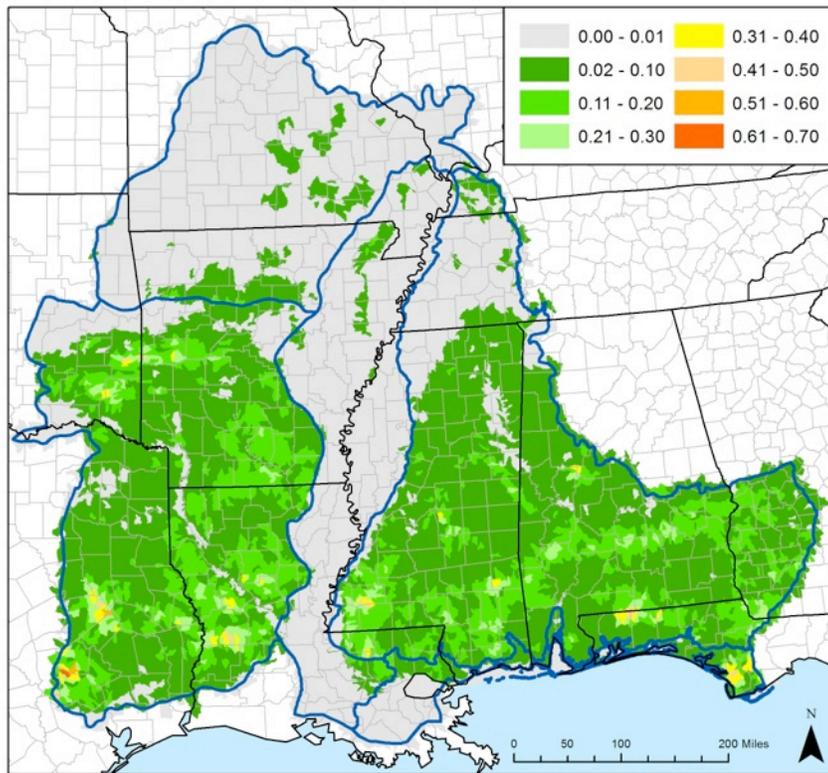


Figure 3. Proportion of watershed (HUC12) area occupied by the top fifth of observations of average diameter per acre within pine-dominant forest systems (top fifth of observations, or quantile, ranges from 6.1" – 18.4").

Diameter at Breast Height (DBH) ≥ 20 square feet per acre of trees ≥ 14 inches

The ISA landscape endpoint is ≥ 20 square feet per acre of trees ≥ 14 " DBH, which can be restated as requiring at least 20 trees of diameter 14" or more per acre. The presence of such large-diameter pine trees is considered a key limiting habitat characteristic for open pine umbrella species such as red-cockaded woodpecker and brown-headed nuthatch. In the EWGCP about 9 million acres, or 5% of the total pine-dominant land use class, are likely to have a relatively high average tree diameter per acre (>6 " average DBH includes sizes ranging from 6.1 to 18.4 inches, making this size class more likely to contain the 20 larger-diameter trees per acre). See Figure 3; see Table 1 for acreage estimates.

Canopy Cover $< 50\%$

This ISA landscape endpoint is defined as overstory tree canopy cover $< 50\%$. Overstory canopy reduction through forest management practices such as periodic thinning or burning allow greater light penetration to the forest floor, which stimulates growth of the herbaceous understory characteristic of pine savanna. Of the ~ 43 million acres of pine-dominant lands within the EWGCP, about 6.3 million acres have canopy cover $< 50\%$ (see Table 1). This comprises about 15% of pine-dominant areas in the EWGCP, or 6% of these subgeographies' total area. In the GCPO overall, about 15% of pine-dominant habitat meets this endpoint condition as well, or 4% of total GCPO acreage.

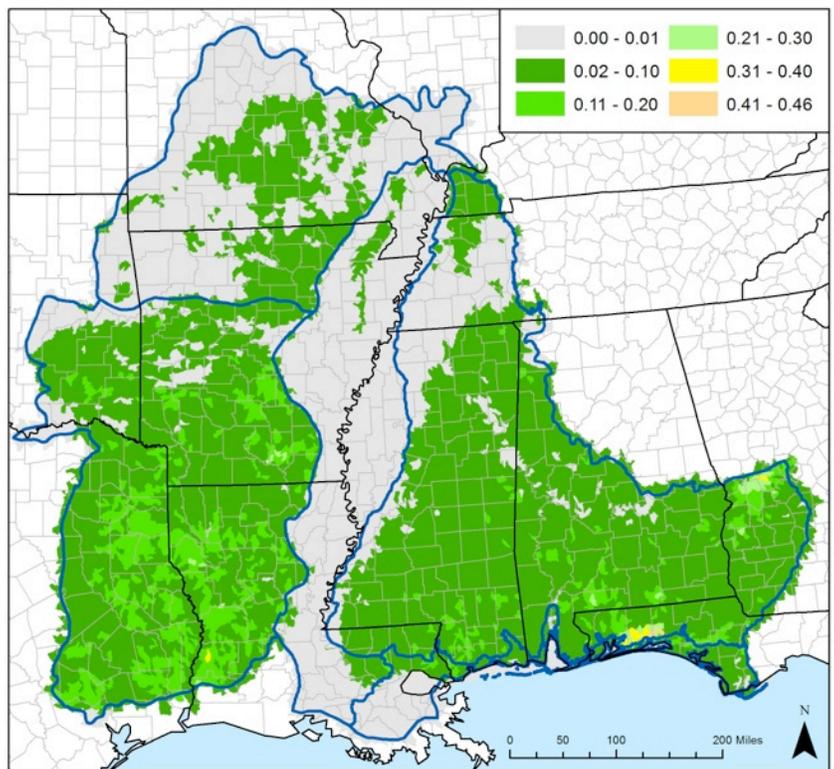


Figure 4. Proportion of watershed (HUC12) area occupied by both pine dominant systems and canopy cover values below the desired threshold value of 50%.

Midstory Shrub & Hardwood Cover <30%

The ISA landscape endpoint is <30% cover for midstory shrubs and <20% cover for midstory hardwoods. The absence or sparse distribution of understory trees and shrubs is associated with higher rates of habitat occupation by red-cockaded woodpecker, brown-headed nuthatch, and northern bobwhite. Data limitations allowed characterization of the midstory canopy generally (all species) rather than addressing the endpoints explicitly. Maps of midstory basal area and midstory stem density (proxy measures for midstory cover) were very similar, indicating strong spatial correlation. They were therefore combined, and results for both indicate the highest concentration of these conditions is in southern portions of the EWGCP and the Gulf Coast (see Figure 5; see Table 1 for acreage estimates).

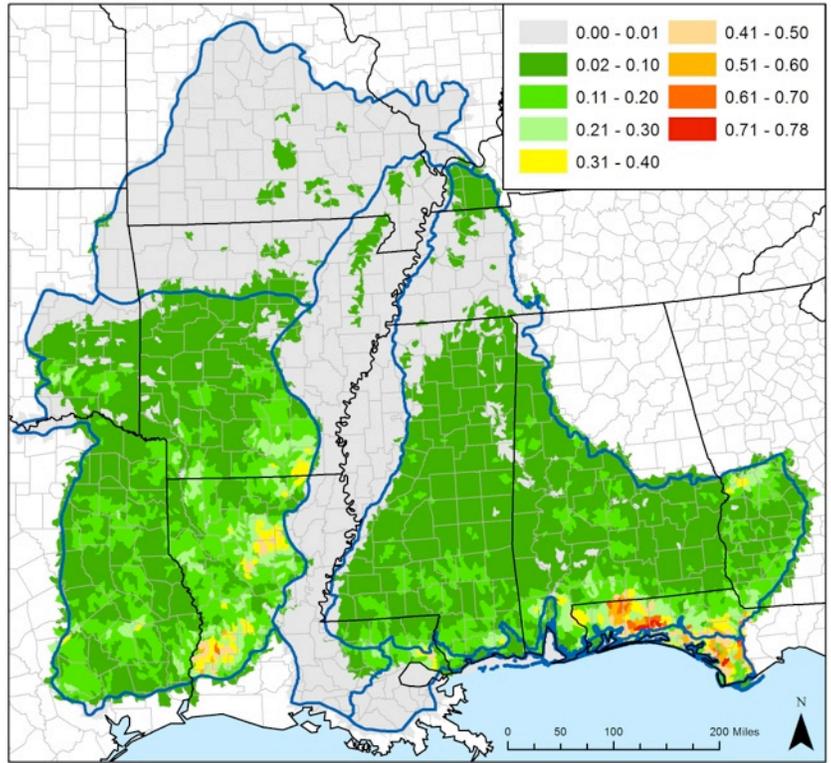


Figure 5. Proportion of watershed (HUC12) occupied by pine dominant systems within the target range of <30% midstory and shrub cover (calculated using proxy measures of midstory basal area and midstory tree density).

Herbaceous Understory >65%

The understory community is an important component of any forest ecosystem, providing habitat, affecting nutrient cycling, increasing species diversity, preventing erosion, and providing fuel to carry fire through the system. In open pine ecosystems, the species-rich understory dominated by grasses is a “hallmark characteristic” of high quality. Moreover, the understory harbors a large portion of the high floristic diversity and endemic species found in southeastern coastal plain pine savannas and woodlands. Mesic longleaf woodlands have 140 species of vascular plants per 1000 m² (highest in the temperate Western Hemisphere). At this time there is no decisive means to provide reasonable measures of forest understory cover at the landscape scale within the GCPO.



Herbaceous understory of longleaf pine in Mississippi - Toby Gray, GCPO LCC



Diversity in longleaf understory-Peter Linehan

Temporal Considerations: appropriate distribution of successional stages

The ISA calls for “an appropriate distribution of successional stages.” However, few studies address what this might be for open pine, and none yet propose any particular distribution in terms of a measurable endpoint. Several species (red-cockaded woodpecker, gopher tortoise, Bachman’s sparrow, northern bobwhite quail, brown-headed nuthatch) show an affinity for mature forests. Thus, the maintenance and restoration of older stands in the near term will be critical to achieving conditions favorable to target wildlife species. On the other hand, some species (e.g. Bachman’s sparrow) use early successional habitats in addition to mature stands. The “appropriate distribution,” then, would include some amount of recently harvested or non-forest land and a much larger portion of mature forest. Regeneration of pine stands on a cyclical basis will be critical over the long term. Figure 6 shows the spatial distribution of stand age classes in pine-dominant areas.

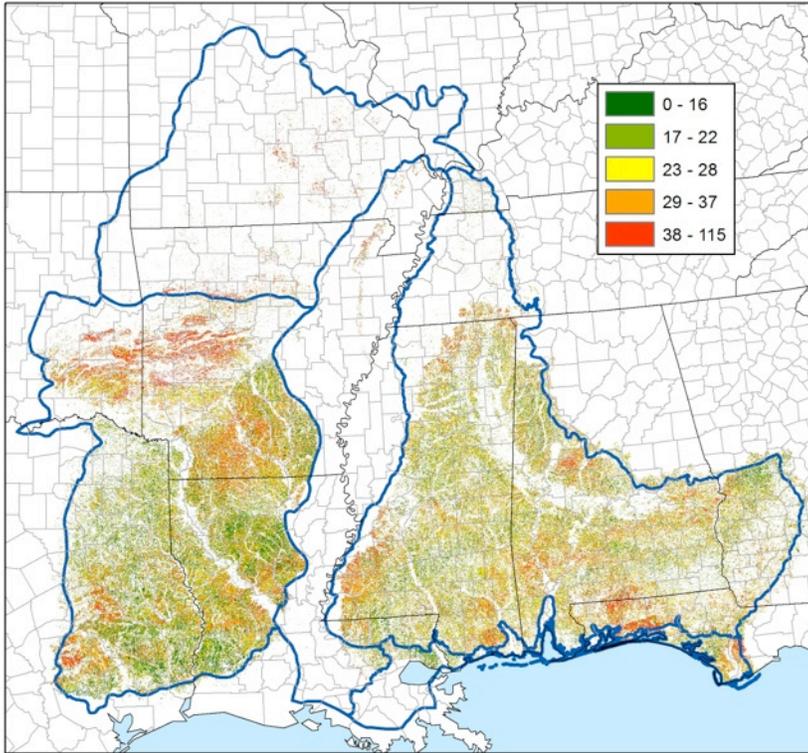


Figure 6. Average stand age per acre in pine dominant habitats of the GCPO, in five age classes.

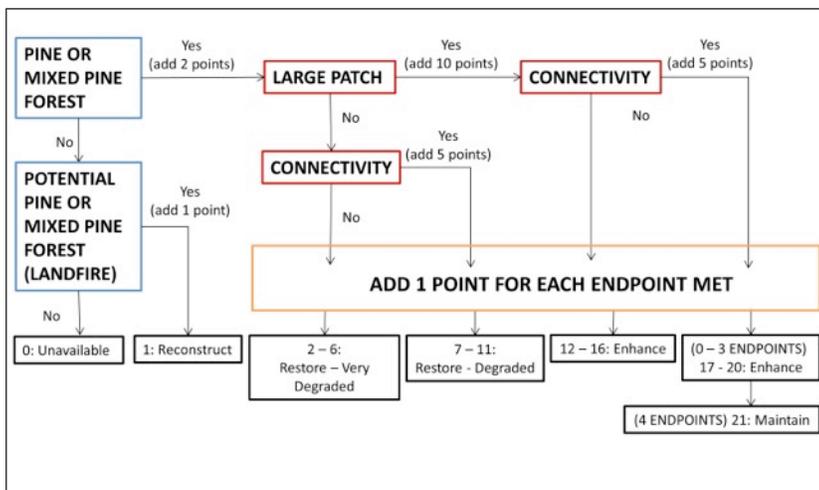


Figure 7. Decision tree showing assessment of desired forest condition endpoints within patch size and connectivity categories.

CONFIGURATION

Patch Size and Connectivity (20 million acres with patches >600 acres and <3km to next nearest patch)

Open pine savanna is a disturbance-dependent system nested within the larger 45-million-acre pine/mixed-pine-hardwood forest matrix that dominates the EWGCP. As such, the system is defined by its condition. Lacking an indication of large, connected patches of Open Pine Woodland Savanna, we applied the patch size (> 600 acres) and connectivity (3 km to the nearest patch) criteria to the 45 million acres of pine and mixed pine ecological system classes, then assessed desired forest condition endpoints within the patch size and connectivity categories through use of a decision tree (Figure 7).

Table 1: Acreage amounts for Open Pine forest condition endpoints. Each endpoint is tallied independently of all others within pine-dominant forests.

SUBGEOGRAPHY	Total Acreage	Pine Dominant Acres	Acres with Basal Area 40 – 70 ft ² /acre	Acres with Average DBH/acre >6" (top fifth)	Acres with Canopy Cover <50%	Acres with lowest combined midstory basal area & midstory tree density (<30% cover)
West Gulf Coastal Plain	52,698,200	22,059,987	8,273,972	3,997,571	3,531,531	5,063,224
East Gulf Coastal Plain	62,412,700	21,388,086	8,024,600	4,250,668	2,856,096	4,659,885
Mississippi Alluvial Valley	25,438,900	336,805	113,314	105,374	85,762	117,591
Ozark Highlands	33,706,600	578,721	160,468	160,602	303,170	92,316
Gulf Coast	6,013,850	1,096,809	502,865	278,826	174,454	788,444
TOTAL	180,270,250	45,460,409	17,075,220	8,793,041	6,951,013	10,721,459

The existence of good quality open pine savanna patches is inferred when all the forest endpoint targets (see Table 1) are met at a particular location. The simple additive mapping procedure used here indicates that the occurrence of all four desired forest conditions within a single 250 meter (15 acre) pixel occurs only on about 144,000 acres widely scattered throughout the region. Of these, about a 100,000 acres occur in patches that meet the desired patch size and connectivity endpoints (Table 2).

The process interprets categories of index values in terms of conservation actions (Reconstruct, Restore, Enhance, Maintain), which are depicted as a regional map in Figure 8. Mapped condition index scores indicate that a few endpoint conditions can be found in vast areas of the forests of the EWGCP. Locations indicating the presence of all six (patch size, connectivity, basal area, DBH, canopy cover, and midstory density/basal area), not visible at the map scale shown in Figure 8, are described in Figure 9 as acreage amounts within watersheds. Watersheds with greater than 500 acres of top-score pixels are associated with Chattahoochee, Marion, and Taylor Counties, Georgia

Table 2: Acres of Pine Forest described by the condition index as meeting landscape conditions (columns) and desired forest conditions (rows).

Number of Endpoints Met	<600 acres no neighbor	<600 acres with neighbor	>600 acres no neighbor	>600 acres with neighbor	TOTAL
0	2,317	3,153,515	44,618	12,376,222	15,576,672
1	4,479	4,615,577	68,989	15,418,988	20,108,033
2	3,320	2,201,016	37,344	5,594,965	7,836,645
3	633	487,246	11,521	1,307,760	1,807,160
4	46	42,826	1,220	99,877	143,970
TOTAL	10,795	10,500,181	163,692	34,797,812	45,472,481

(Fort Benning area); Decatur County, Georgia; Escambia County, Florida; and Beauregard Parish, Louisiana.

GCPO LCC staff are in the process of revising methods for interpreting and displaying the condition index. Future drafts of these maps will feature better ways of showing which specific desired forest conditions are met, both within and outside the patch size and connectivity parameters.

Opportunities for Management

As demonstrated by the success of [America's Longleaf Restoration Initiative](#), which is on target to achieve its restoration goal of increasing longleaf from 3.4 to 8 million acres by the year 2020, open pine systems are responsive to management designed to restore or maintain the system. The [Shortleaf Pine Initiative](#) is a similar, more recent effort aimed at restoring shortleaf, also a historically open pine system.

Given the malleable character of these systems, this rapid assessment is not focused solely on quantifying where open pine forest is in good condition now. It is hoped that the assessment will also have the potential to provide information useful in identifying both general locations and management needs for restoring open pine. For example, areas where basal area exceeds the desired maximum of 70 ft²/acre may indicate opportunities for restoration by thinning (shown in Figure 8). Similar analyses could also be performed for other metrics as well, producing overlays of data pointing to areas where management adjustments would be desirable to benefit wildlife.

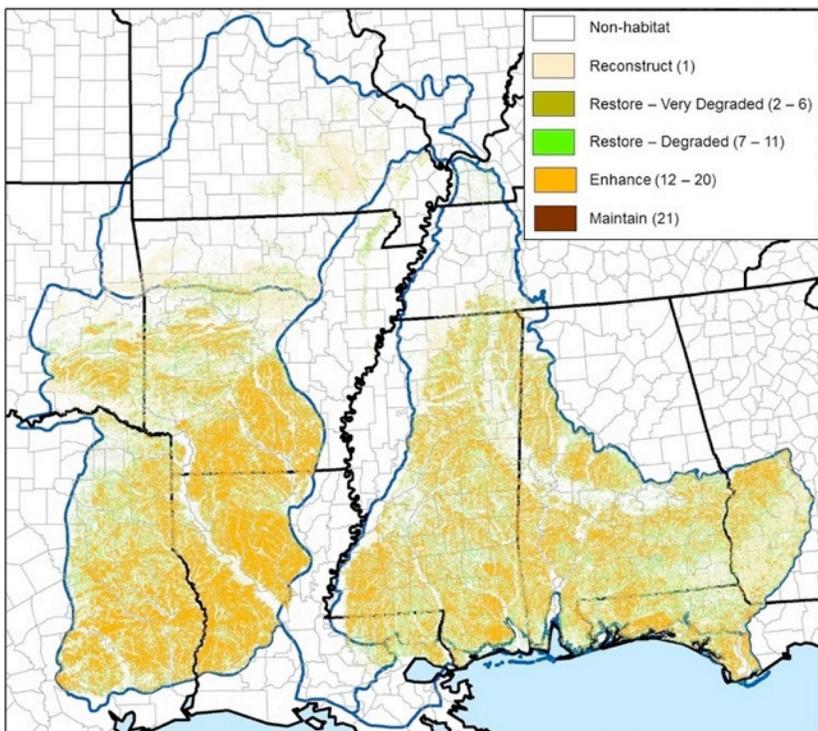


Figure 8: Categories of Open Pine Condition Index scores indicate patch size and connectivity endpoints are met in much of the coastal plain, and the occurrence of all six conditions within a pixel is rare.

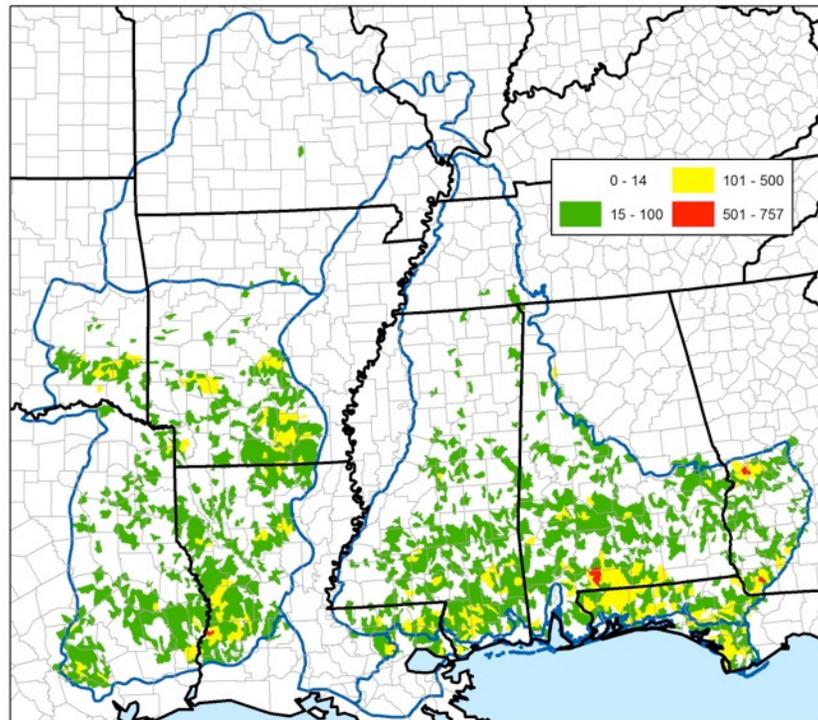


Figure 9. Acreage amounts of top-score pixels within watersheds. A 250-meter pixel covers 15.44 acres; watersheds with no representation have no top-score pixels, and green watersheds have at least one.

Opportunities for Improving Data

- ★ Data on herbaceous cover in forested areas is collected and processed on only a few selected locations within our geography. Tremendous potential exists for "scaling up" assessments of this important forest characteristic to a regional level, including expanding plot-level sampling and utilizing increasingly available data from LiDAR, unmanned aerial vehicles (UAVs), and satellite-based sensors.
- ★ The assessment of the diameter at breast height (DBH) endpoint can be improved by developing a procedure using existing [Forest Inventory & Analysis](#) plot level data to estimate the likelihood that >20 square feet of basal area per acre is accounted for by trees with DBH >14". Such an analysis was beyond the scope of a rapid ecological assessment, for which the simpler metric of average diameter per acre was used.
- ★ There is a need for better understanding of the composition of successional stages needed to maintain healthy long-term open pine communities and the data that would facilitate assessment of this characteristic at the landscape scale.