EAST AND WEST GULF COASTAL PLAINS:

GRASSLAND-PRAIRIE-SAVANNA

Introduction

The Nature Conservancy considers temperate grasslands to be a major habitat type of global conservation concern (The Nature Conservancy 2006). The presence of grassland-prairie-savanna systems is generally considered a function of climate, with the grassland biome occupying a transitional zone between arid deserts and mesic forests (Whittaker 1975, Axelrod 1985, Lomolino 2006, Bailey 2009). In the southeastern United States, a region that receives more than enough rain to support forest, an ecologically significant aggregation of grassland systems exists due to interactions between soil parent material , disturbance patterns (including wind, fire, and grazing), and other factors (Noss 2014, DeSelm and Murdock 1993). So-called "blackland" prairies exist, usually in belted formations associated with calcareous substrates, in Texas, Louisiana, Arkansas, Mississippi, and Alabama (Peacock and Schauwecker 2003). Natural grassland ecosystems in North America are considered critically imperiled, having been reduced from their pre-European settlement extents by about 98%, mostly due to conversion to agriculture and other land uses (Anderson 2006, Noss et al. 1995, Chapman et al. 1990).

The historical extent of natural grassland in the Southeast has been a matter of debate. Bartram (1791) described extensive prairies in what is now Gainesville, Florida and in Montgomery County, Alabama. In Mississippi, state geologists Harper (1857) and Hilgard (1860) described prairies associated with calcareous clays on Cretaceous formations in Pontotoc, Tishomingo, Itawamba, Chickasaw, Monroe, Lowndes, Oktibbeha, Noxubee, and Kemper Counties in Northeastern Mississippi, and on Eocene formations in Wayne, Clarke, Jasper, Smith, and Scott Counties in central Mississippi. Lowe (1915) and Fenneman (1938) referred to these two regions as the Black Prairie Belt and Jackson Prairie Belt respectively. Rostlund (1957) argued that the historical existence of the Black Belt as a distinct vegetative zone is a "myth" because small patches of open land occur naturally throughout the Southeast and their concentration in the Black Belt is the result of extensive modification by human beings. Barone's (2005a) review of all the relevant citations in Rostlund (1957) along with several additional historical sources, including georeferenced General Land Office data from the 1830's, indicates that prairies, while never the dominant land form, were a distinct, coherent, and ecologically important feature in the Southeast before cotton-based agriculture began to replace the native vegetation in the mid-eighteenth century. Deselm and Murdock (1993) offered the first comprehensive monograph of southeastern grasslands of the interior highlands, upper to middle coastal plain, and the

coastal prairie. More recently, the grassland chapter in a textbook on North American vegetation restricts the grassland biome to the central part of the continent and recognizes no Southeastern grasslands with the exception of the coastal prairie of Eastern Texas and Southern Louisiana (Sims and Risser 2000). Noss (2013) notes that some of the confusion arises from a developing understanding of the interaction of natural fire and forest succession: many geographers of the mid-twentieth century believed fire in southeastern landscapes to be entirely anthropogenic and that pine forests, including the longleaf pine wiregrass woodland and savanna systems, constitute successional, fire-dependent stages that would, in the absence of humans, revert to mixed hardwood climax forests. Most modern ecologists reject this interpretation because little evidence exists to suggest that people can "create" grassland over larger areas, and plenty to suggest that lightning ignitions, fuels derived from the effects of hurricanes and other wind events on vegetation, and edaphic conditions combine to favor grassland over forest in parts of the Southeast. These natural grasslands provided humans with "something to work with," an opportunity to expand existing grassy openings through use of their flammable components in order to diversify a landscape to suit their needs (Noss 2013).

During the period of European settlement, grasslands were often the first land cover types to be converted to farmland because their soils were productive (or assumed to be) and labor-intensive tree removal was unnecessary. In the nineteenth century, the forced migration of much of the native population to Indian Territories and the establishment of permanent town and homesteads suppressed the free-roaming, landscape-scale fires associated with grassland evolution and ecology. On many former grasslands with productive soils, agriculture continues today. Where the soil has been depleted or was poor to begin with, some former grasslands are used as pastures, and many unmanaged areas have succeeded to woodlands or even forests in the absence of disturbance. These factors, fire suppression and conversion to other land uses, have reduced the number and size of native prairies to the degree that very little remains today, mostly in the form of small patches (0.5 to 5.0 ha) in abandoned pastures, along roadsides, in power line rights-of-way and on public and private natural areas (Peacock and Schauwecker 2003). As this ecologically important component of the landscape disappears, so do the animal species that depend upon it for habitat. Jordan (1997) describes the conversion of the tallgrass prairies of the Midwest to agricultural use as a "cataclysmic change" occurring within a single life span: "[a]t no other time in history had an entire landscape been changed so dramatically and in so short a time."

Desired Ecological State

The Draft v4 Integrated Science Agenda (ISA) established by the Adaptation Management Science Team (AMST) of the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative (GCPO LCC) conceives of conservation design in terms of habitat management, or the application of specific actions on the land to achieve specific measurable outcomes. These outcomes reflect the desired states for ecological

systems and can be quantified as “endpoints”. The ISA establishes 5 subgeographies for the GCPO LCC and associates certain “Broadly Defined Habitats” developed by NatureServe and the U. S. Fish and Wildlife Service, with each of them. Grasslands, along with Open Pine Woodland and Savanna and Medium-low Gradient Streams and Rivers, are high priority habitat types within the East and West Gulf Coastal Plains subgeographies. The ISA includes a general description of the desired ecological state and a set of configuration and condition endpoints for Grassland-Prairie-Savanna:

> Relatively large patches of dense, tall, and diverse native warm season grasses and forbs.
>
> Amount and Configuration
> 100,000 ac
> Large patches of prairie
> 5 patches >10,000 ac
> 500 patches >100 ac
>
> Condition
> Vegetation height (grass): 4-6’
> Vegetation density: very high – nearing 100%
> Bare ground: >5% but <20% (indicative of interspersion among bunch grasses)
> Shrub cover: <20%
> Tree density: <10/ac
>
> Composition
> Dominated by native warm season grasses and forbs
>
> Temporal considerations:
> A 5-year return interval on disturbance, with 20% of all grasslands disturbed annually

These desired states are defined in terms in terms of species’ limiting factors in the ISA. For each priority system, a representative pool of species was derived from the Species of Greatest Conservation Need listed in State Wildlife Action Plans. From these, a subset of species limited by the habitat conditions reflected in the endpoints were selected (Table 1). Four of the seven selected species are associated with no more than one endpoint, and only one species, Northern Bobwhite, is associated with more than two endpoints.

Table 1: Desired Landscape Endpoints for Grasslands and Initial Assessment of Species Limited by Habitat Characteristics Reflective of These Endpoints, as presented in the Draft ISA, Appendix 3.

Desired Landscape Endpoints	Grasshopper Sparrow	Northern Bobwhite	Dickcissel	Henslow's Sparrow	Texas Horned Lizard	Eastern Meadowlark	Painted Bunting
Prairie patch size	x	x					
Vegetation Height			x				
Vegetation Density		x		x	x	x	
Bare Ground		x					
Shrub Cover		x					x
Tree Density	x		x				
Warm Season Grass Density		x					

Assessment Process

Grassland-Prairie-Savanna in the GCPO was assessed by applying a pixel-by-pixel decision tree process to the appropriate geospatial data in the region. The first branch of the tree asks whether the pixel is a grassland or not. If not, the NLCD "developed" class and LANDFIRE biophysical settings layers are used to determine whether the pixel has potential to become a grassland. The branches for grassland pixels divide the set into those for which we have "high confidence" that prairie conditions (warm season native grasses and forbs) exist and those that are simply grasslands (forest regeneration, pasture hay, old fields, unmanaged grasslands in a variety of conditions). The "high confidence" pixels are a combination of selected LANDFIRE evt classes and polygons of known prairie restoration and conservation areas converted to a raster data layer. The branches then further subdivide those sets based patch size criteria before assigning a single point for each desired condition indicated (Figure 1).

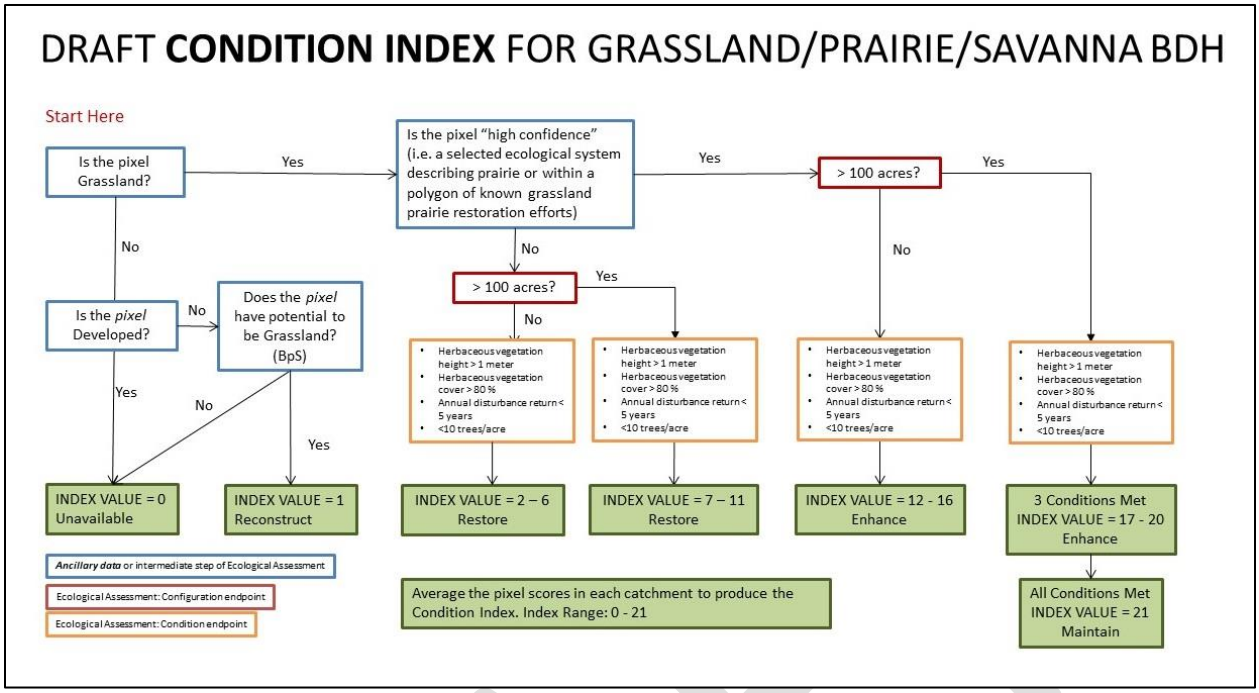

Figure 1: Pixel-based dichotomous tree for generating a condition index score for Grassland-Prairie-Savanna.

Defining "Grasslands"

Grasslands, broadly defined, are areas with few trees or shrubs, dominated by grasses (members of the family Poaceae), with a component of non-graminoid herbaceous species called forbs (Anderson 2006, Diamond and Elliot 2015, Noss 2013, Estes et al. 2016). There is no consensus on which land cover or ecological systems classes should be included in this broad definition. All literature on grasslands addresses prairies, barrens, and savanna. Some writers, but not all, also include planted pasture (Diamond and Elliot 2015), longleaf pine woodland (Noss 2013), glades (Noss 2013), riverscour (a flood-maintained grassland associated with riparian cobble and exposed bedrock, Estes et al. 2016), and herbaceous wetlands such as canebrakes, bogs, fens, and meadows (Estes et al. 2016).

Our answer to the first two questions in the dichotomous tree (Figure 1), i. e., is it grassland, and if so, is it prairie, is based on a crosswalk of three national level ecological system data layers (NatureServe, National Gap Analysis Program, LANDFIRE existing vegetation type), three state-level vegetation mapping systems (Texas, Oklahoma, and Florida), the Broadly Defined Habitats described in the ISA, and grassland vegetation classes described in Noss 2013. All land cover and ecological system data layers were clipped to a 2 km buffer of the HUC12 watersheds intersecting the GCPO geography for the crosswalk. Our selection of grassland and prairie classes followed a set of guidelines:

- Woodlands are not included since they are addressed in other chapters
- Glades, generally defined as relatively small grassy patches on shallow substrates or exposed bedrock, principally in the highlands, are not included as grasslands and are addressed separately. So-called Nepheline, Weches, or saline glades, found in the West Gulf Coastal Plain, are included here since they are not addressed elsewhere. Approaches in the parsing of glades and prairies vary across the GCPO.
- Wet prairies and "floodplain herbaceous" classes are included, whereas marshes, sedgelands, and other classes closely associated with water bodies are excluded.
- Herbaceous or grass cover in developed areas, such as parks and airports, are excluded, even though some species of concern use these landscapes. For example, Stuttgart Municipal Airport, located in the Grand Prairie region of Arkansas, protects some remnant prairie and is a designated Important Bird Area by BirdLife International. Known patches of conservation such as this are included in the Assessment and the condition index as "State-level" contributions (described below), but the associated land cover classes were excluded from the crosswalk because developed land and conservation are considered incompatible generally.
- Identifying a subset of "prairie" ecological system or vegetation classes among the more general set of grassland classes relies in part on the degree to which native species vs. exotic species are emphasized in the class description, and on indications of how the land is used. This selection process considers all prairies to be grasslands, but not all grasslands to be prairies.

The application of these standards across all the national and state-level vegetation classification systems is challenging due to the fact that descriptions of grasslands can be confusing and inconsistent across agencies and across the region. Also, rejected and accepted classes are often intermixed in the physical landscape, such as when savannas grade into woodlands, or barrens intermix with glades.

Selecting a Mapped Vegetation Classification System

Algorithms for discerning warm season from cool season grasses by patterns in electromagnetic reflectance, sometimes termed "spectral signature," across large landscapes have not been developed. In the various national-scale land use/land cover mapping projects, such as the National Land Cover Database (NLCD), The Gap Analysis Program (GAP), NatureServe, and LANDFIRE existing vegetation type (evt), native prairie is often misclassified as pasture/hay, cultivated crops, harvested forest/successional regeneration, or other herbaceous classes. We examined land cover and ecological system classes described by these four products at three known locations of restored or maintained grassland-prairie-savanna (Morton-Marathon Road Prairie, Pulliam Prairie, and Black Prairie Wildlife Management Area, all in Mississippi)

in order to determine which national classification system holds the most promise for guiding a rapid ecological assessment. Tabulations of land cover classes described by each data product were generating by collapsing the specific classes into more broadly defined groups. As a result of this analysis, LANDFIRE evt was selected as the best way to describe grasslands generally and the more specific subset of prairie grasslands at a region-wide scale.

One of the four known prairie sites is presented here to illustrate the differences in how the spatial data layers describe prairie (Figure 2). Pulliam Prairie is a 250 acre, privately-owned Black Belt prairie remnant in Chickasaw County, Mississippi. The site was the subject of an extensive 2009 floristic study (Campbell and Seymour 2012) and a field trip destination for the 2012 Southeastern Prairie Symposium at Mississippi State University.

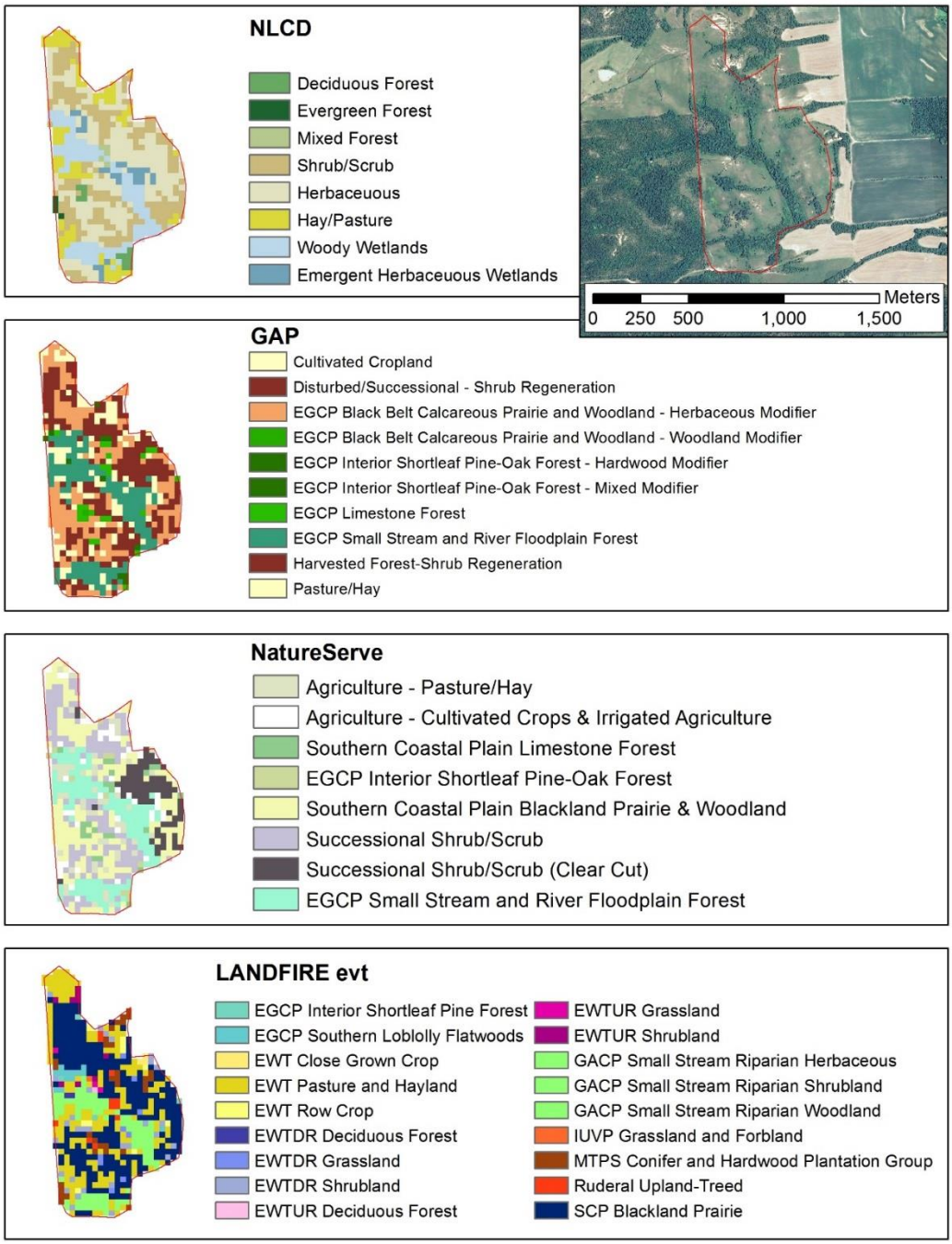

Figure 1: Ecological system and land cover maps of Pulliam Prairie in Chickasaw County, Mississippi. Note: EGCP = East Gulf Coastal Plain; EWT = Eastern Warm Temperate; EWTDR = Eastern Warm Temperate Developed Ruderal; GACP = Gulf and Atlantic Coastal Plain; IUVP = Introduced Upland Vegetation Perennial; MTPS = Managed Tree Plantation Southeast; SCP = Southern Coastal Plain

When the specific vegetation classes are collapsed into broader categories, the NatureServe and GAP layers are seen to be identical, a result noticed for the other three sites as well. LANDFIREevt identifies a greater number of pixels as Blackland

Prairie and correctly rules out cultivated crops, whereas NatureServe and GAP misidentify seven percent of the pixels as cultivated crops (Table 2).

Table 2: Percent class cover for Pulliam Prairie

Class	NLCD	GAP	NatureServe	LANDFIRE evt
Forest	3	25	25	9
Shrub/Scrub	28	32	32	6
Natural Prairie	0	27	27	40
Other Grasslands	34	0	0	2
Pasture/Hay	13	9	9	27
Cultivated Crops	0	7	7	2
Wetlands	21	0	0	14
TOTAL	100	100	100	100

Similar results were found with the other three known prairie sites. While no currently available geospatial data layer accurately parses natural prairie from other grassland types, LANDFIREevt identifies slightly higher amounts of prairie cover in areas where it is known to exist. Furthermore, LANDFIREevt is far more likely to describe prairie as pasture/hay, which is at least a grassland type, rather than cultivated crops, which is not (Figure 3). Configuration and pixel counts for broad classes are identical for NatureServe and GAP, although the individual class names are different, with GAP using more modifiers and sub-classes. NLCD's "71/ Grassland/Herbaceous" classification is too broad for identifying natural prairie, but could be useful as a general grassland layer. LANDFIREevt was chosen as the basis for a grassland-prairie-savanna map of the GCPO.

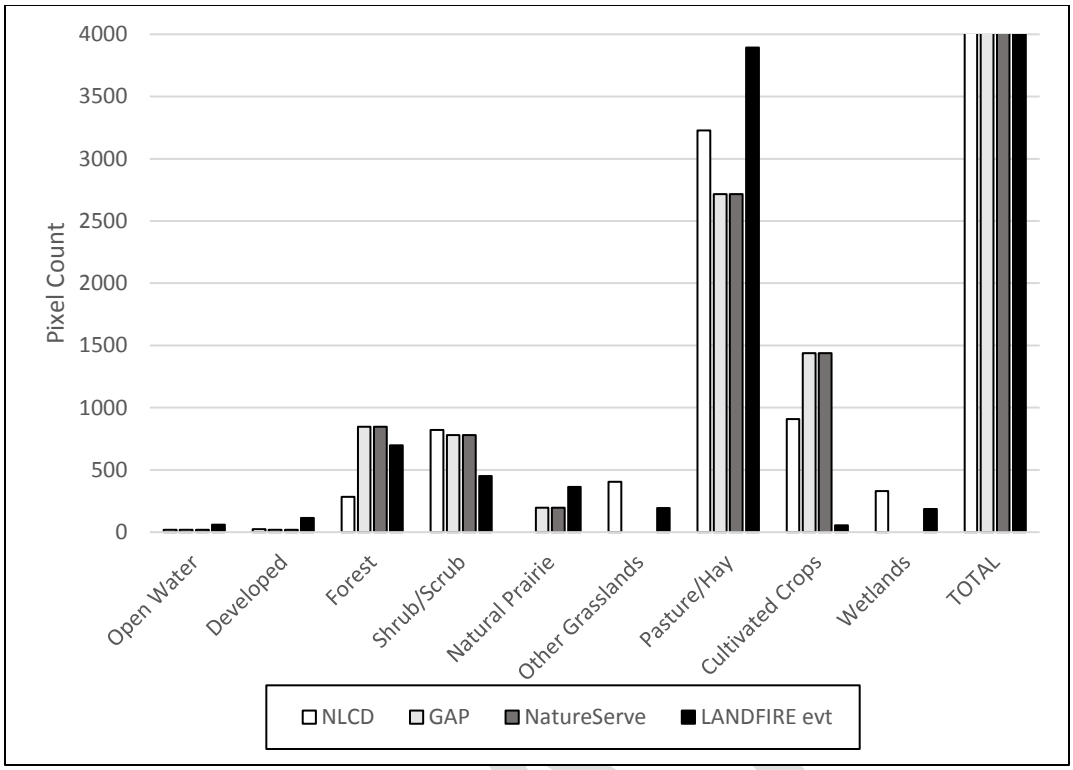

Figure 3: Total pixel counts of Land Cover and Ecological System classes in three known prairie locations, as described by NLCD, GAP, NatureServe, and LANDFIREevt.

We developed Prairie Masks from the four land cover / ecological system data layers using the crosswalk and guidelines described above. The results are shown as percentages of total land cover in HUC12 watersheds in Figure 4. The NLCD map describes an exclusive selection of class 71, Grassland/Herbaceous. Classes selected for the GAP, NatureServe, and LANDFIRE evt Prairie Masks are listed in Appendix I. The Jackson Prairie Belt is a region in Central Mississippi known to support prairie patches (Fenneman 1938, Moran et al. 1997, Barone 2005b). The GAP and NatureServe data products identify no prairie vegetation classes in the Jackson Belt, whereas LANDFIRE evt probably overestimates the amount of prairie in that region.

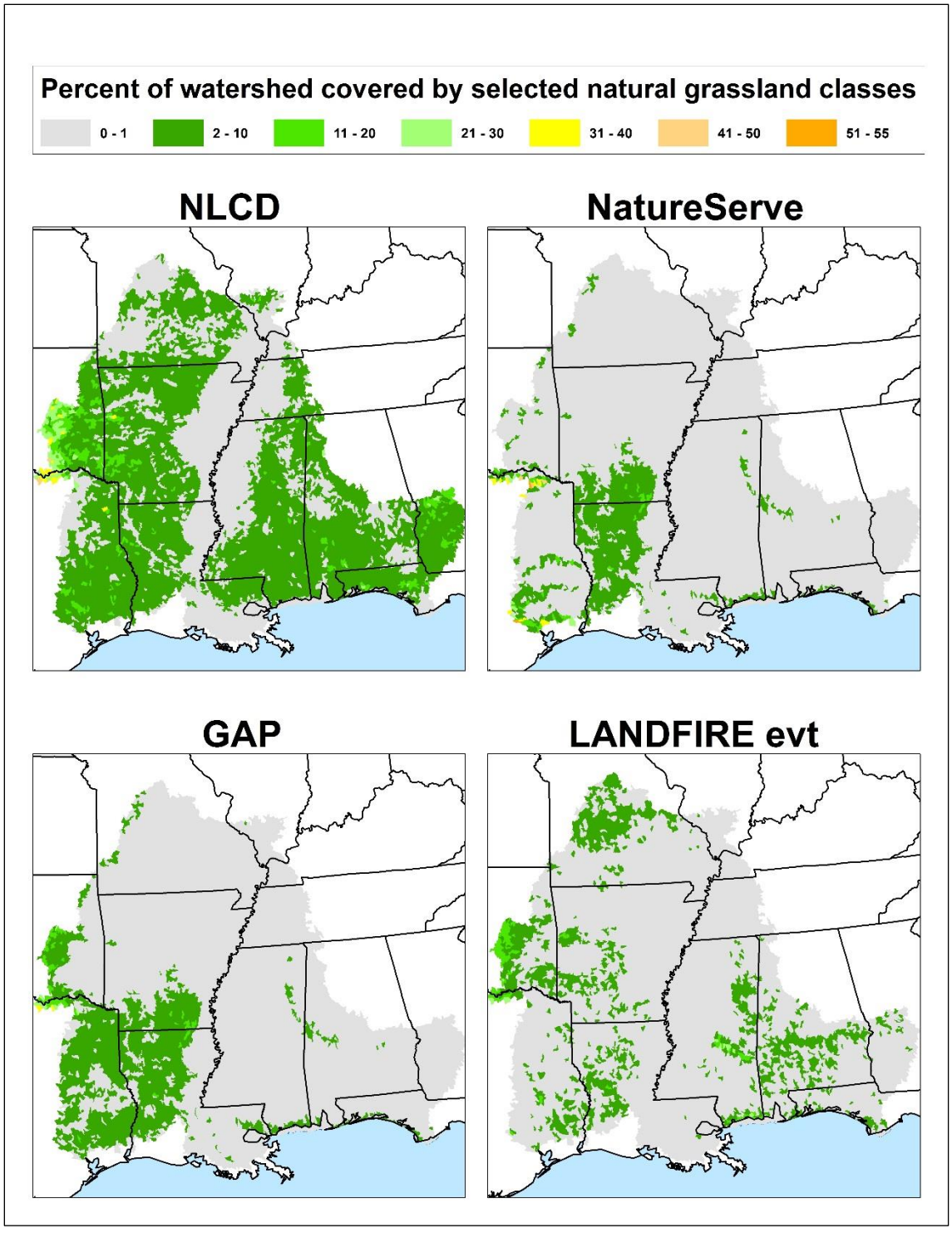

Figure 4: Natural grassland and prairie land cover and ecological system classes mapped by four spatial data products and summarized as percent cover of HUC12 watersheds.

LANDFIRE evt does not provide class descriptions, so classes were selected (or rejected) based on descriptions of similarly or identically named classes in the crosswalk. As mentioned above, the selection process seeks to exclude woodlands and

glades (while allowing some rare glade types in the West Gulf Coastal Plains that are not included in other broadly defined habitats), allows classes of wet prairie while excluding marsh, pondshore, riparian, and other grass-dominated wetlands, and identifies a subset of “prairie” grasslands characterized by the presence or emphasis of native plant species in the class description. The process resulted in the selection of 44 vegetation types (Table 3).

Table 3: Selected grassland classes from LANDFIREevt

LANDFIRE value	LANDFIRE evt name	Also Prairie
3415	Arkansas Valley Prairie and Woodland	YES
3274	Central Interior and Appalachian Floodplain Herbaceous	
3132	Central Mixedgrass Prairie Grassland	YES
3421	Central Tallgrass Prairie	YES
3433	East Gulf Coastal Plain Jackson Prairie	YES
3568	East Gulf Coastal Plain Jackson Prairie Woodland	YES
3485	East Gulf Coastal Plain Savanna and Wet Prairie	YES
3577	East Gulf Coastal Plain Wet Prairie Grassland	YES
3578	East Gulf Coastal Plain Wet Prairie Shrubland	YES
3977	Eastern Cool Temperate Pasture and Hayland	
3954	Eastern Cool Temperate Undeveloped Ruderal Grassland	
3273	Eastern Great Plains Floodplain Herbaceous	
3997	Eastern Warm Temperate Pasture and Hayland	
3959	Eastern Warm Temperate Undeveloped Ruderal Grassland	
3332	Gulf and Atlantic Coastal Plain Floodplain Herbaceous	
3182	Introduced Upland Vegetation-Perennial Grassland and Forbland	
3539	Modified/Managed Northern Tallgrass Grassland	YES
3540	Modified/Managed Southern Tallgrass Grassland	YES
3394	North-Central Interior Oak Savanna	YES
3412	North-Central Interior Sand and Gravel Tallgrass Prairie	YES
3290	North-Central Oak Barrens Herbaceous	YES
3418	Pennyroyal Karst Plain Prairie and Barrens	YES
3195	Recently Burned-Herb and Grass Cover	YES
3191	Recently Logged-Herb and Grass Cover	
3529	Ruderal Upland Herbaceous	
3423	Southeastern Great Plains Tallgrass Prairie	YES
3430	Southern Coastal Plain Blackland Prairie	YES
3567	Southern Coastal Plain Blackland Prairie Woodland	YES
3419	Southern Ridge and Valley Patch Prairie	YES
3438	Tamaulipan Savanna Grassland	YES
3422	Texas Blackland Tallgrass Prairie	YES

3486	Texas Saline Coastal Prairie	YES
3434	Texas-Louisiana Coastal Prairie	YES
3403	West Gulf Coastal Plain Catahoula Barrens	YES
3405	West Gulf Coastal Plain Nepheline Syenite Glade	YES
3428	West Gulf Coastal Plain Northern Calcareous Prairie	YES
3429	West Gulf Coastal Plain Southern Calcareous Prairie	YES
3967	Western Cool Temperate Pasture and Hayland	
3944	Western Cool Temperate Undeveloped Ruderal Grassland	
3254	Western Great Plains Floodplain Herbaceous	
3148	Western Great Plains Sand Prairie Grassland	YES
3149	Western Great Plains Shortgrass Prairie	YES
3416	Western Highland Rim Prairie and Barrens	YES
3987	Western Warm Temperate Pasture and Hayland	

Grasslands described by the National Agricultural Statistics Service

We obtained additional information about the amount and configuration of grasslands from the Cropland Data Layer (CDL) available from the USDA National Agricultural Statistics Service (NASS). The CDL is a raster, geo-referenced, crop-specific land cover data layer created annually for the continental United States using moderate resolution satellite imagery and extensive agricultural ground truth. Developed by the USDA, National Agricultural Statistics Service, Research and Development Division, Geospatial Information Branch, Spatial Analysis Research Section, the CDL provides acreage estimates to the Agricultural Statistics Board for the state's major commodities and produces digital, crop-specific, categorized geo-referenced output products.

We downloaded a user-defined subset of the 2015 CDL data layer from NASS and re-projected it to the working projection (NAD 1983 Albers) before clipping to a 2 km buffer of the HUC12 watersheds intersecting the GCPO geography. We reclassified the data layer, retaining the classes Clover/Wildflowers and Grass/Pasture and removing all others. Combining this output with selected grassland/prairie classes of LANDFIRE evt resulted in the addition of about 28 million pixels (about 6 million acres) to the Grassland Mask.

Grasslands enrolled in the Conservation Reserve Program (CRP)

The most comprehensive regional effort to conserve or restore grasslands on private land comes from the constellation of voluntary USDA initiatives authorized under periodic Farm Bill legislation designed to control commodity production and offset land conversion. These include grassland practices established under programs such as general and continuous sign-up Conservation Reserve Program (CRP), Agriculture

Conservation Easement Program (ACEP), and Sodsaver provisions of the 2014 Farm Bill and partnership endeavors like the Regional Conservation Partnership Program (RCCP). However, restrictions to accessing spatially-explicit information related to Farm Bill grassland practices complicates efforts to assess this (or any) priority system in terms of a regional network of lands and waters.

According to practice descriptions available online from the USDA CRP Practices Library, the following CRP practices could be considered relevant to a regional assessment of grassland/prairie/savanna (Table 4):

Table 4: CRP practices relevant to grassland conservation

Number	Name	Description
CP1	Introduced Grasses and Legumes	Establishes vegetative cover to reduce erosion and provide habitat to gamebird and other species
CP2	Native Grasses	Establishes native grasses to reduce erosion and provide habitat to gamebird and other species
CP4B	Wildlife Habitat Corridors	Uses grass, wildflower, tree, or shrub plantings in linear strips at least 66 feet wide to provide habitat for wildlife
CP4D	Permanent Wildlife Habitat	Provides cover, nesting, and food resources to bird and mammal species
CP8	Grass Waterway	Uses grass cover to move water across a field minimizing erosion and reducing the delivery of sediment to lakes, streams, and rivers
CP15	Contour Grass Strips	Grass strips that follow natural contours
CP21	Grass Filter Strips	Protects streams, wetlands, lakes, and ponds by trapping sediment, nutrients, and other pollutantxs
CP25	Rare and Declining Habitat	Restores rare and delclining habitat such as tallgrass prairie, wet meadows, and sage steppe with apporpriate native plant species
CP 29	Wildlife Habitat Buffer (Marginal Pasture)	Uses native grasses as buffers to water bodies to reduce sediment, nutrient, and pesticide runoff and to provide habitat for wildlife
CP 30	Marginal Pasture Land Wetland Buffer	Establishes grass buffers bordering water bodies to reduce sediment, nutrient, and pesticide runoff
CP33	Upland Bird Habitat Buffer	A narrow band of native grasses, legumes, forbs, &/or shrubs located around the perimeter of cropland fields that provides habitat for bobwhite quail, ring-necked pheasant, and other upland birds. Land must have a cropping history.
CP38	State Acres For wildlife Enhancement (SAFE)	Through SAFE, producers create habitat that is beneficial to the target high-priority wildlife species. This may involve planting trees, grasses, forbs, or other species that help to restore or improve wildlife habitat. Specific SAFE conservation practices are set forth in each state's SAFE project.

CP41	Flooded Prairie Wetland	Part of the Farmable Wetlands Program. Producers plant resource-conserving covers to prevent the degradation of wetland areas.
CP42	Pollinator habitat planting	Supports reproduction and growth of plants important to pollinators such as bees, butterflies, moths, beetles, flies, wasps, birds, and bats.

Additionally, the Environmental Quality Incentives Program (EQIP), administered by the Natural Resources Conservation Service (NRCS), provides assistance to landowners in the practice of natural resource conservation on agricultural land and non-industrial forestland. These practices include the creation and improvement of habitats for at-risk wildlife. Program participants work with a certified Technical Service Provider to develop a Conservation Action Plan for their land. Each state manages a particular set of EQIP practices related to their particular resource concerns, some number of which include habitat restoration for grassland species. We currently have no means for assessing the amount and configuration of these managed landscapes in a region as large as the GCPO.

State-level contributions

Polygons of observed prairie patches from state-level sources were added to the set of selected classes from the LANDFIRE evt data layer in order to enhance the map of grassland/prairie/savanna in the GCPO. The contributions from state level organizations are described in detail in Appendix II. Each of these contributions were ultimately combined with the selected LANDFIRE evt pixels and compiled into a single raster image representing “high confidence” of the presence of prairie habitat. Ultimately we obtained useful data from seven of the twelve states within our geography, creating four grassland and six prairie data layers (Figure 5).

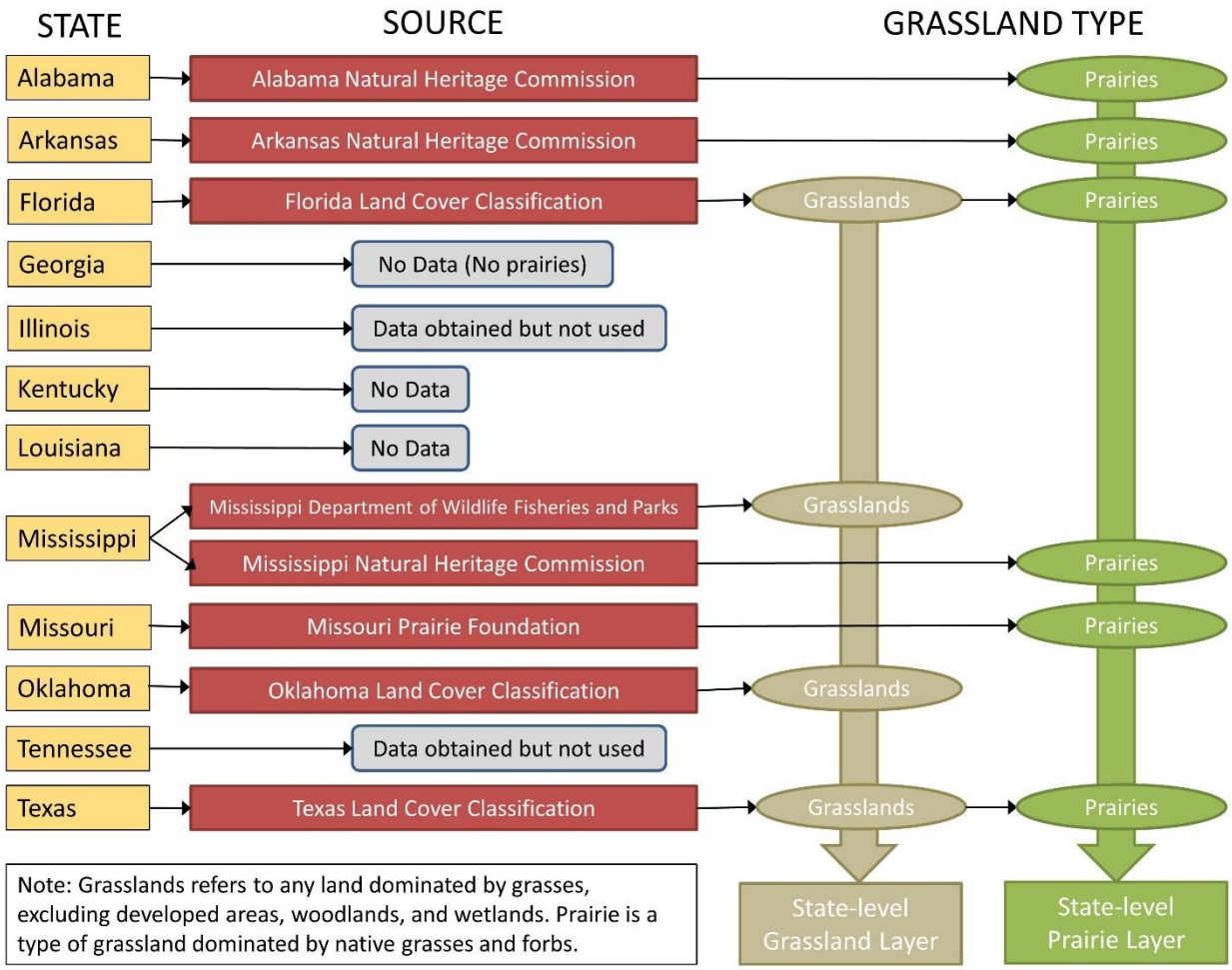

Figure 5: State-level contributions to the Grassland/Prairie/Savanna ecological assessment

The list of known prairie patches was enhanced by incorporating information received from state-level partners with patches described in Noss (2013), DeSelm and Murdock (1993), Peacock and Schauwecker (2003), Adelman and Schwartz (2013), and to polygons described by the Protected Areas Database of the United States (PAD-US). Use of all these sources combined resulted in the generation of 14,716 polygon describing prairie patches totaling 33,654 acres. We also compiled 94 additional mentions of prairie locations for which no polygons were available. All known prairie patches derived from these sources are listed by state in Appendix II.

Result: A Grassland-Prairie Mask.

Selected LANDFIRE evt classes and state-level data layers were combined to create a spatial data layer indicating the presence of grassland in the GCPO (Figure 6), along with an additional layer representing the more restrictive set of grasslands having prairie characteristics, that is, that are dominated by native vegetation (Figure 7). About 32 million total acres of grassland are indicated, including 1 million acres of prairie (Table 5).

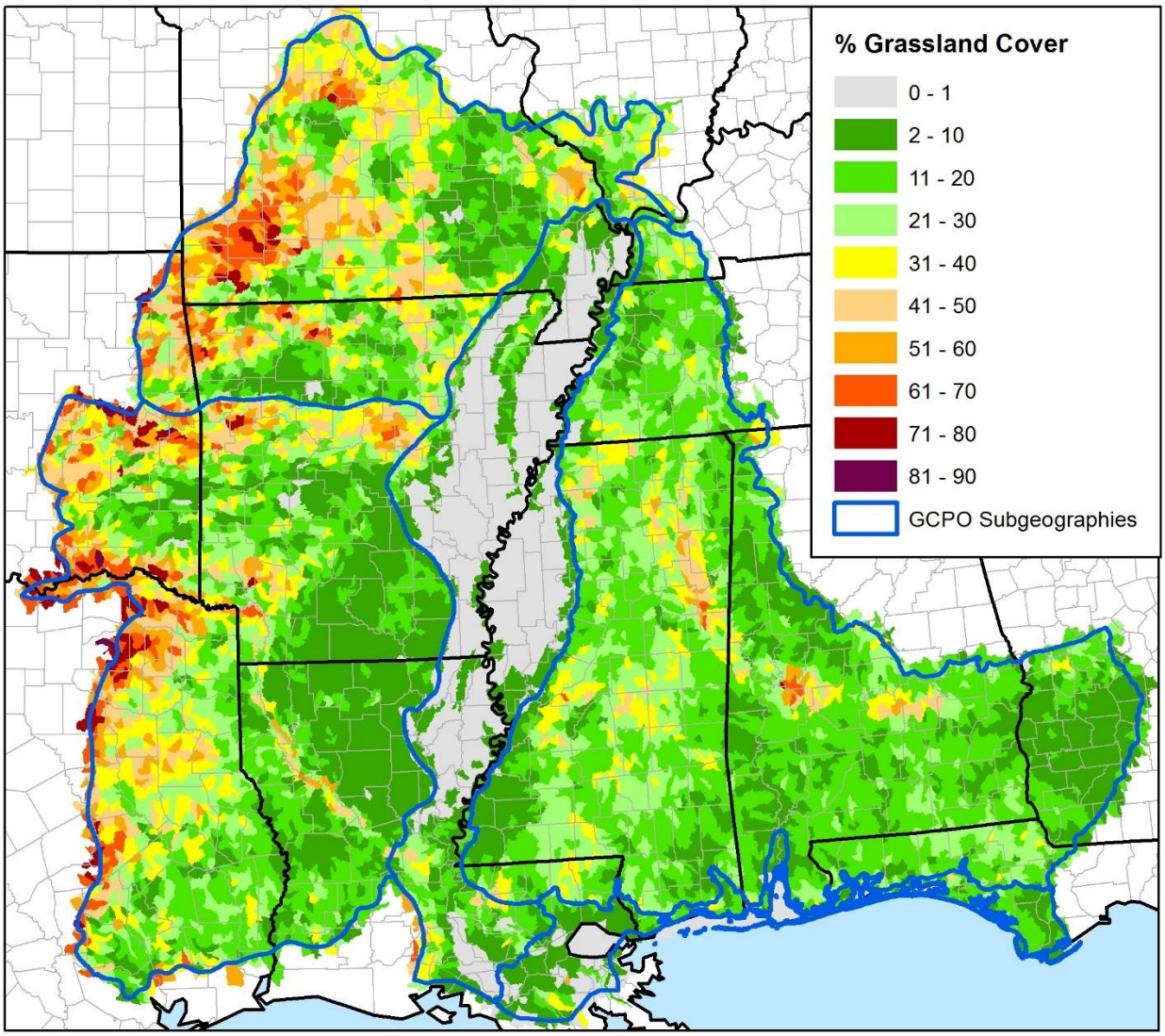

Figure 6: Grassland summarized as percent of total coverage in HUC12 watersheds.

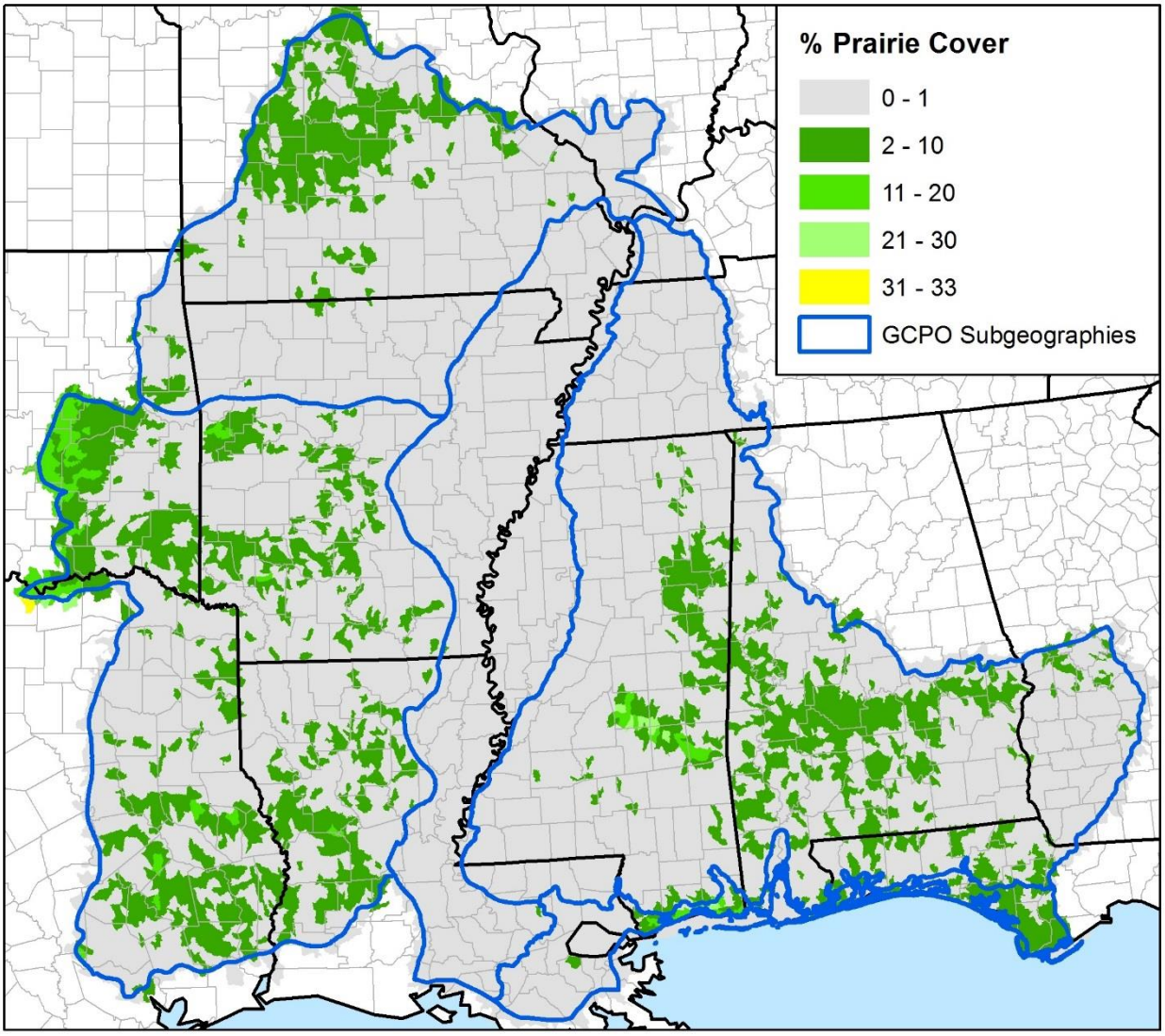

Figure 7: Prairie summarized as percent of total coverage in HUC12 watersheds.

Table 5: Acres of grassland and prairie by subgeography

Subgeography	Acres grassland	Acres prairie
West Gulf Coastal Plain	11,505,453	355,349
East Gulf Coastal Plain	9,523,949	238,948
Mississippi Alluvial Valley	962,743	6,065
Ozark Highlands	9,770,677	324,683
Gulf Coast	424,565	121,040
TOTAL	32,187,387	1,046,085

Condition Index

Desired habitat conditions are difficult to measure across large landscapes, particularly in a dynamic, disturbance-driven system such as grasslands. A desired minimum vegetation height of one meter does not imply that the cover remain so at all times, but rather that post-disturbance (after mowing or burning), the vegetation is allowed to grow to such a height and remain so for some period of time until the next disturbance event. The amount of bare ground per acre, an important predictor of occupation for some ground birds, is best measured at the site. Data layers derived from remote sensing products, used in this section, are the best estimates we have for a region-scale estimation of these conditions. As estimates, these spatial data products, and the spatial data output layers we have derived from them, represent the current best approximation of how the desired conditions are configured over large areas. Managers and planners working at local scales should understand the coarse nature of these products, and utilize them in the context of available local knowledge.

Each pixel in the Grassland Mask is assigned a condition index based on configuration and condition variables outlined in the ISA. All input data layers were converted to NAD 1983 Albers and, if necessary, resampled to 30 meter resolution. National level data was clipped to a 2 km buffer of the set of HUC12 watersheds that intersect the GCPO geography. State level datasets were converted to raster and extended to that same polygon for processing. Following the decision tree process described in the Introduction (Figure 1), the endpoint evaluations are described below.

Potential Grassland

The assessment of potential grassland applies to those pixels outside the Grassland Mask. Much of the presettlement grassland/prairie has been converted to agriculture or grown into forest classes of land. This step acknowledges potential grasslands that have been converted or have transitioned naturally to other ecological system classes. To identify potential natural landscapes, we consulted the LANDFIRE Biophysical Settings (BpS) data layer, which represents vegetation that may have been dominant on the landscape at the time of European settlement. Acreage amounts for 16 selected grassland classes are shown in Table 6 and mapped in Figure 8.

Table 6: LANDFIRE Biophysical Settings classes describing grasslands in the GCPO

VALUE	LANDFIRE BpS name	Acres
2146	Arkansas Valley Prairie and Woodland - Prairie	691,916
2147	Arkansas Valley Prairie and Woodland - Woodland	594,769
1694	Central Mixedgrass Prairie	177
2029, 2046, 2148	Central Tallgrass Prairie	721,810
2082	East Gulf Coastal Plain Jackson Plain Prairie and Barrens	6,642

1313, 1800	East Gulf Coastal Plain Savanna and Wet Prairie	382,385
1525	Lower Mississippi Alluvial Plain Grand Prairie	720,645
2144	North-Central Interior Oak Savanna	3,876,398
1707, 2047, 2149	Southeastern Great Plains Tallgrass Prairie	1,943,054
1440, 1706, 1748	Southern Blackland Tallgrass Prairie	274,660
1775	Southern Coastal Plain Blackland Prairie and Woodland	1,154,248
1751	Tamaulipan Savanna Grassland	19
1443, 1509, 1749	Texas-Louisiana Coastal Prairie	484,126
1760	Texas-Louisiana Saline Coastal Prairie	2
1441, 2150, 1442, 1524	West Gulf Coastal Plain Northern Calcareous Prairie	471,151
1695	Western Great Plains Sand Prairie	431
TOTAL		**11,322,432**

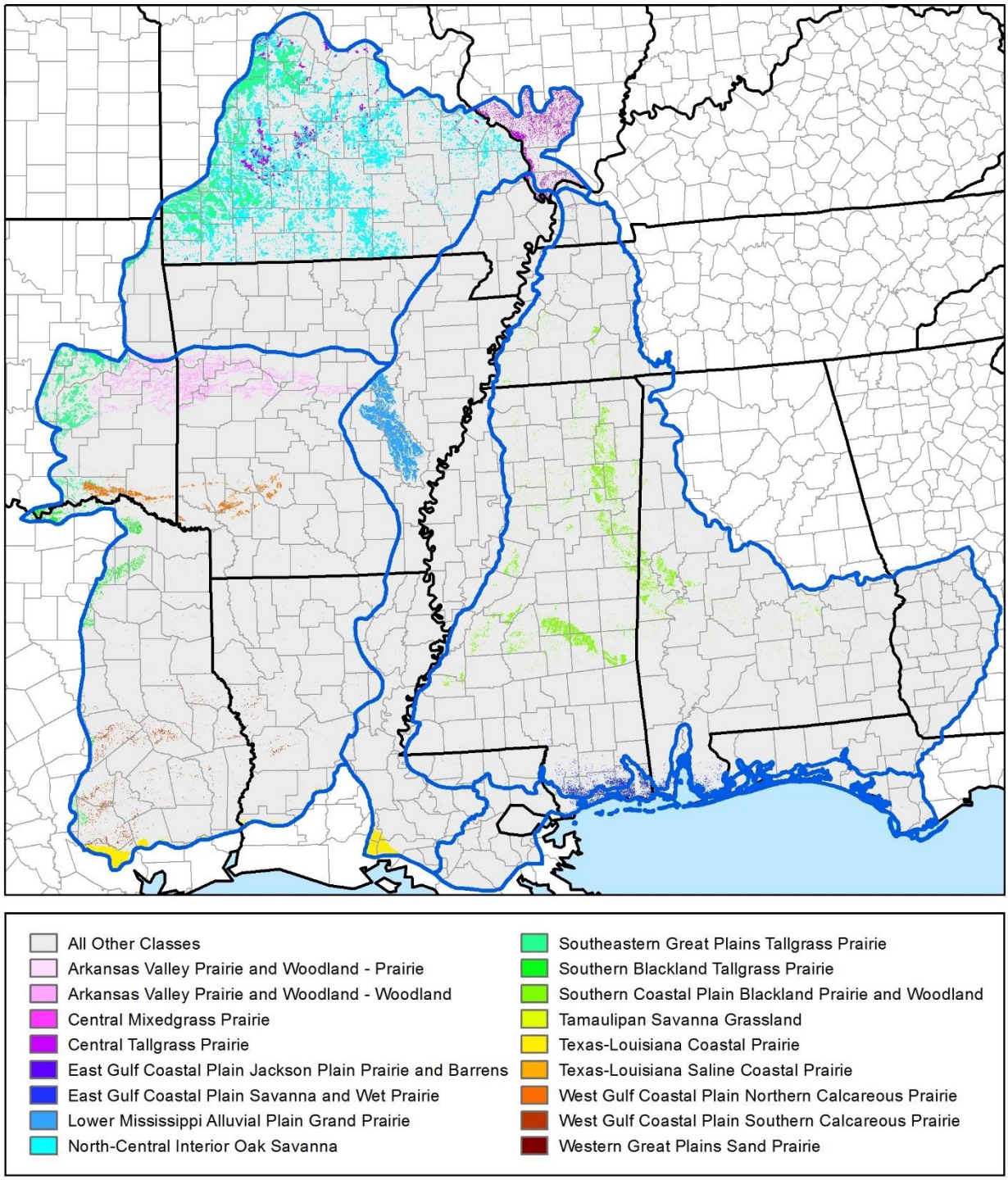

Figure 8: Grassland classes that may have been present at the time of European settlement in the GCPO, according to LANDFIRE's Biophysical Settings data layer.

Geoprocessing

In order to address only those cells outside the Grassland Mask, we extracted the selected BpS classes through a reversed Grassland Mask (Zero value pixels reclassified as 1, values of 1 classified as NoData). We then masked the BpS layer

again removing any pixels described as developed or as open water in the National Land Cover Database 2011 (NLCD) data layer. This step assumes that conversion of potential natural habitat currently occupied by developed classes of land cover or man-made reservoirs and ponds is not worth the time or effort.

This step resulted in a raster data layer in which each pixel described as grassland in BpS, not described as open water or developed in NLCD, and not described as part of the Grassland Mask, is given a value of 1 and all other pixels are given a value of 0.

Vegetation height
Metric: Grass 4 - 6'

The Draft ISA associates vegetation height with dickcissel (ISA appendix 3 and Table 1, above). Vegetation height is a consistent predictor of habitat use by some grassland birds, perhaps because it provides concealment and cover from predators and wind (Fisher and Davis 2010). Definitions of "vegetation height" vary in the literature, and include maximum vegetation height, mean vegetation height, and the height at which the tallest vegetation contacted the Robel or Wiens pole (Fisher and Davis 2010).

This endpoint was assessed using the Existing Vegetation Height data product from LANDFIRE (LANDFIREevh). This layer represents the average height weighted by species cover based on the existing vegetation type (evt) lifeform. The process uses field reference data, Landsat, elevation, and ancillary data in a decision tree model to render specific height class layers for each lifeform. The applicable LANDFIREevh class for this endpoint is "herbaceous height > 1 meter." We generated a raster layer from pixels in this class that are also included in the Grassland Mask. About 2.3 million acres in the GCPO meet both criteria. The results are summarized as percentages of HUC12 watersheds in Figure 9. The distribution of the three height classes of the herbaceous lifeform as described by LANDFIREevt (without regard to the Grassland Mask) is shown in Figure 10.

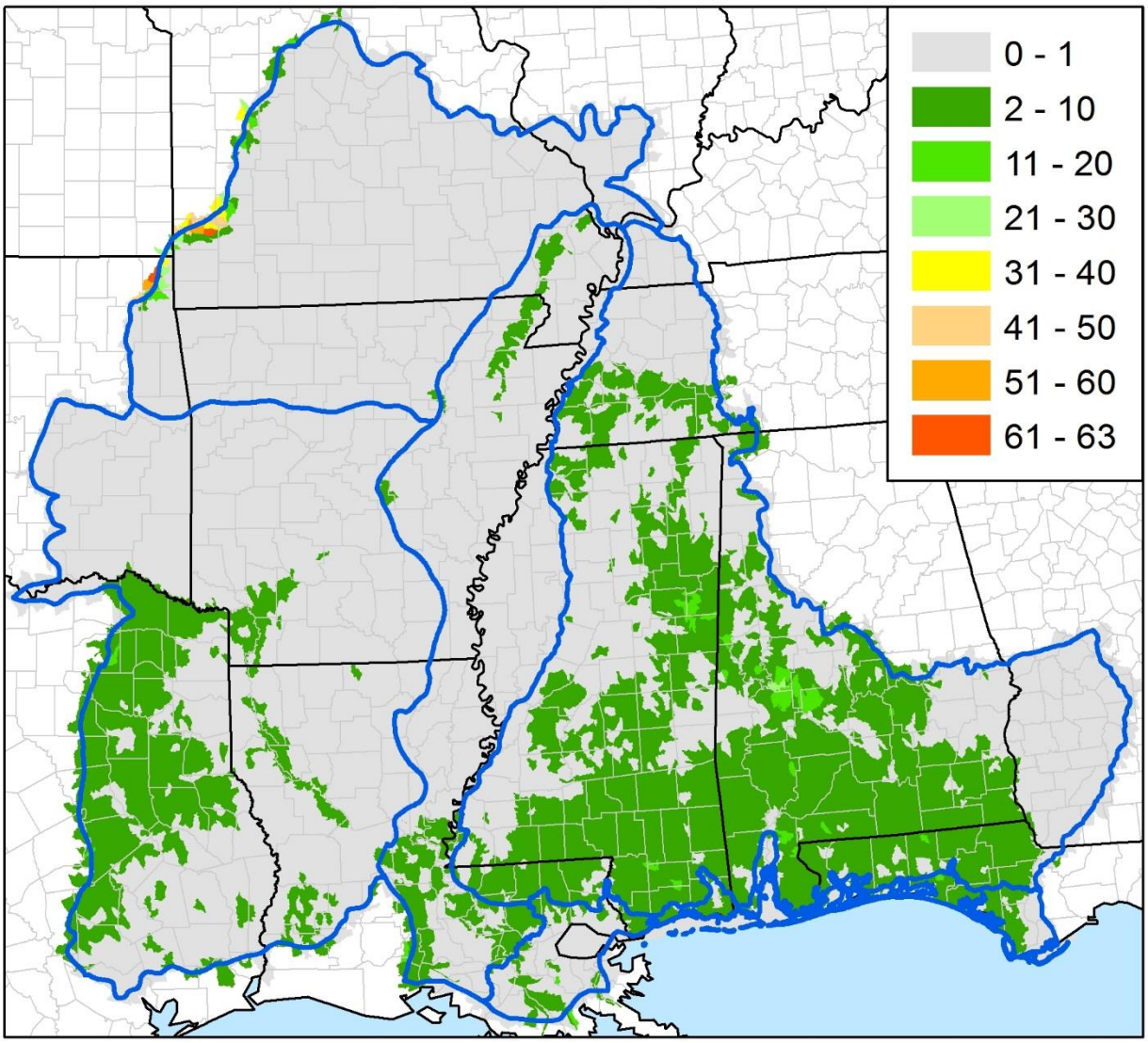

Figure 2: Land that is indicated as being herbaceous and > 1 meter height according to LANDFIREevh, and also described as a selected grassland type, according to LANDFIREevt and state-level inputs (Grassland Mask), summarized as percentage of total coverage in HUC12 watersheds.

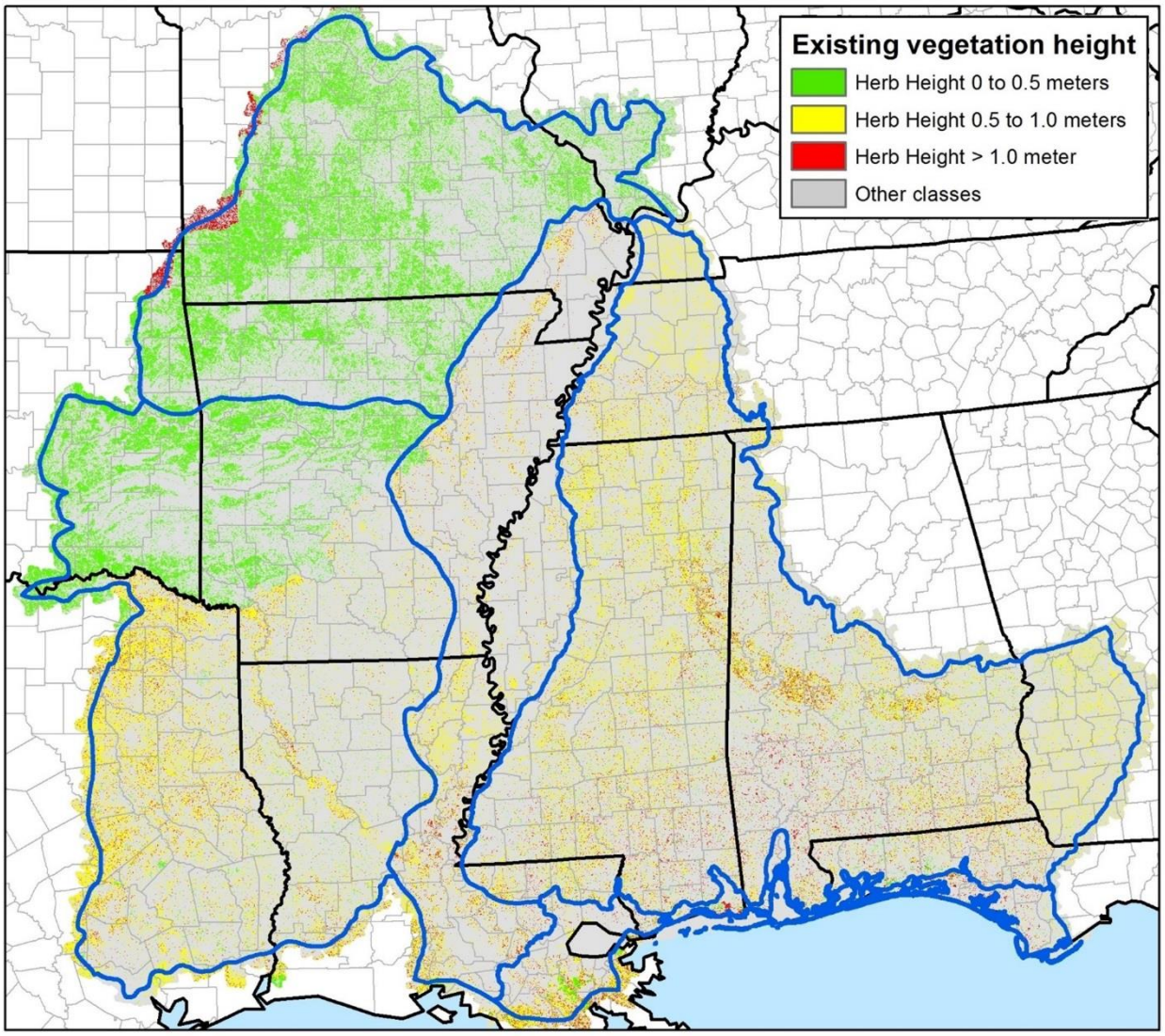

Figure 3: Bins of the herbaceous landform described by LANDFIREevh in the GCPO, without regard to the Grassland Mask.

This step resulted in a raster data layer in which each pixel described as herbaceous and >1 meter in height, and also described as part of the Grassland Mask, is given a value of 1 and all other pixels are given a value of 0.

Limitations:
Vegetation height is more dynamic in herbaceous systems when compared to forested systems: it responds rapidly to disturbance and changes through the growing season. Although the class of >1 meter best approximates the ISA endpoint of 4 – 6", an acknowledgment that the class of 0.5 – 1 meter is preferable to the class of 0 – 0.5 meter might improve the assessment. The existing vegetation height data layer is problematic in that the 0 – 0.5 meter class is bounded by a prominent seam that follows the boundary between the Interior Highlands and the Mississippi Alluvial Valley

subgeographies in the north and between the Ouachita Mountain and South Central Plains ecoregions (EPA Level III, not shown) in the south. LANDFIRE data products are continually revised, and future iterations should indicate a more realistic distribution of the shortest class across the region.

Vegetation density

Metric: Very high-nearing 100%

Density is measured per unit of area or volume. We are unsure how to apply a density metric to grassland systems and we know of no geospatial data product that addresses this metric. A data layer describing percent of herbaceous cover was used to assess bare ground and shrub cover and is discussed below.

Bare ground and Shrub Cover

Bare ground metric: >5% but <20% (indicative of interspersion among bunch grasses)

Shrub cover metric: <20%

The Draft ISA associates bare ground with northern bobwhite and shrub cover with northern bobwhite and painted bunting (ISA appendix 3 and Table 9, above). The presence of available woody cover improves characteristically low winter survival rates for northern bobwhites (Janke et al. 2015). Percentage of bare ground is considered the most important predictor of habitat use by grassland birds (Fisher and Davis 2010).

We used the Existing Vegetation Cover data product from LANDFIRE (LANDFIRE evc) to estimate areas where these conditions are met in the landscape. The LANDFIRE evc layer represents the vertically projected percent cover of the live canopy layer separated by tree, shrub, and herbaceous lifeforms for a 30-meter grid cell. Lacking geospatial data layer estimates of percentage of bare ground, use of the LANDFIRE evc layer for this condition endpoint assumes that bare ground accounts for the remainder of each pixel not covered by the dominant life form. Three attribute categories from this layer apply to these two endpoints and were selected: shrub cover >= 10 and <20%, Herb cover >= 80 and <90, and Herb cover >= 90 and <= 100%. This selection satisfies the desired condition that bare ground is <20% but does not satisfy the condition that it be >5%. These three vegetation cover classes, filtered by the Grassland Mask, are summarized as percentages of total cover in HUC12 watersheds in Figure 11. The selected vegetation cover classes are shown in raster format without regard to the Grassland Mask in Figure 12.

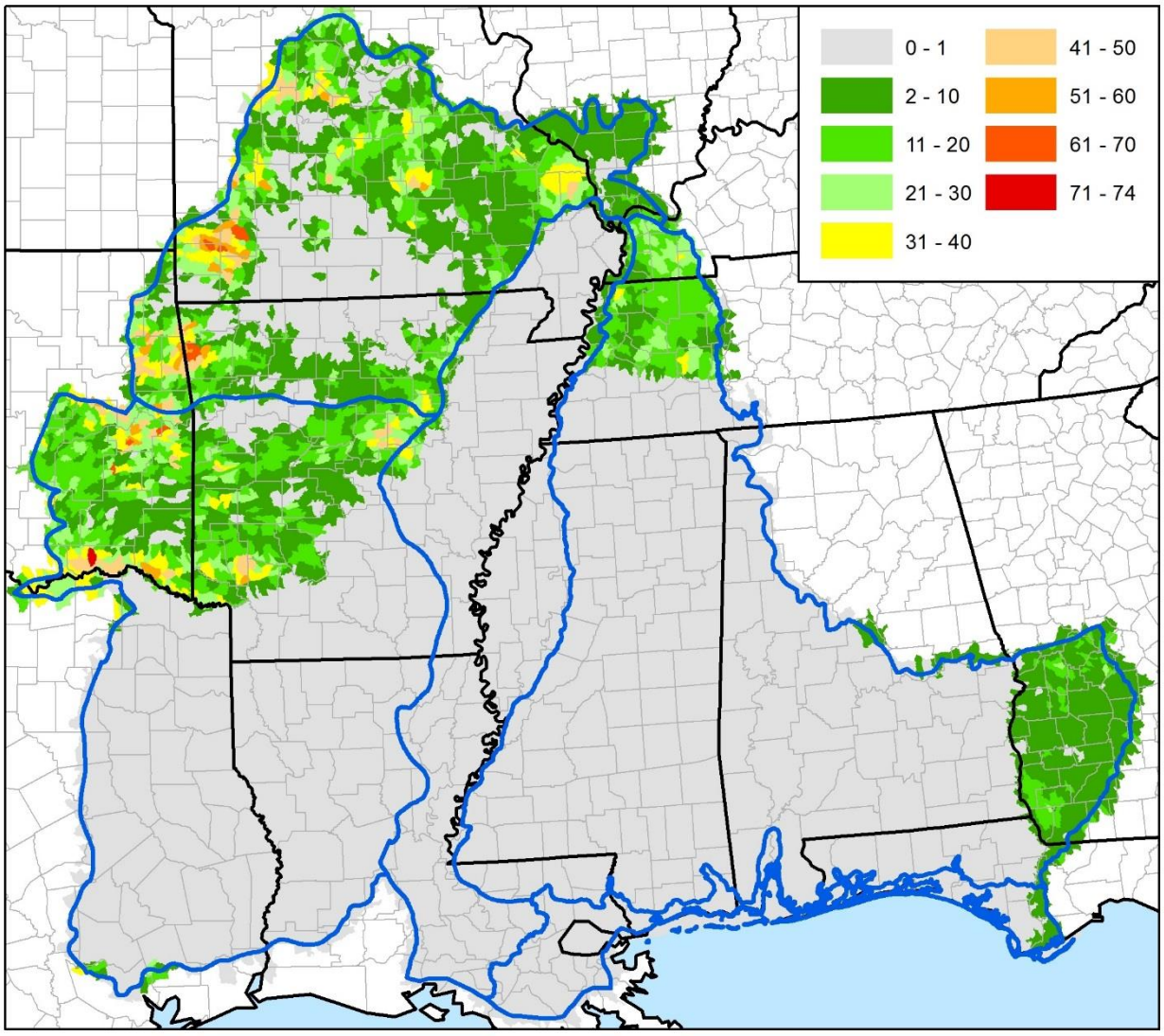

Figure 4: Land that is indicated as having herbaceous cover > 80% or shrub cover < 20% according to LANDFIREevc, and is also described as a selected grassland type, according to LANDFIREevt and state-level inputs (Grassland Mask), summarized as percentage of total coverage in HUC12 watersheds.

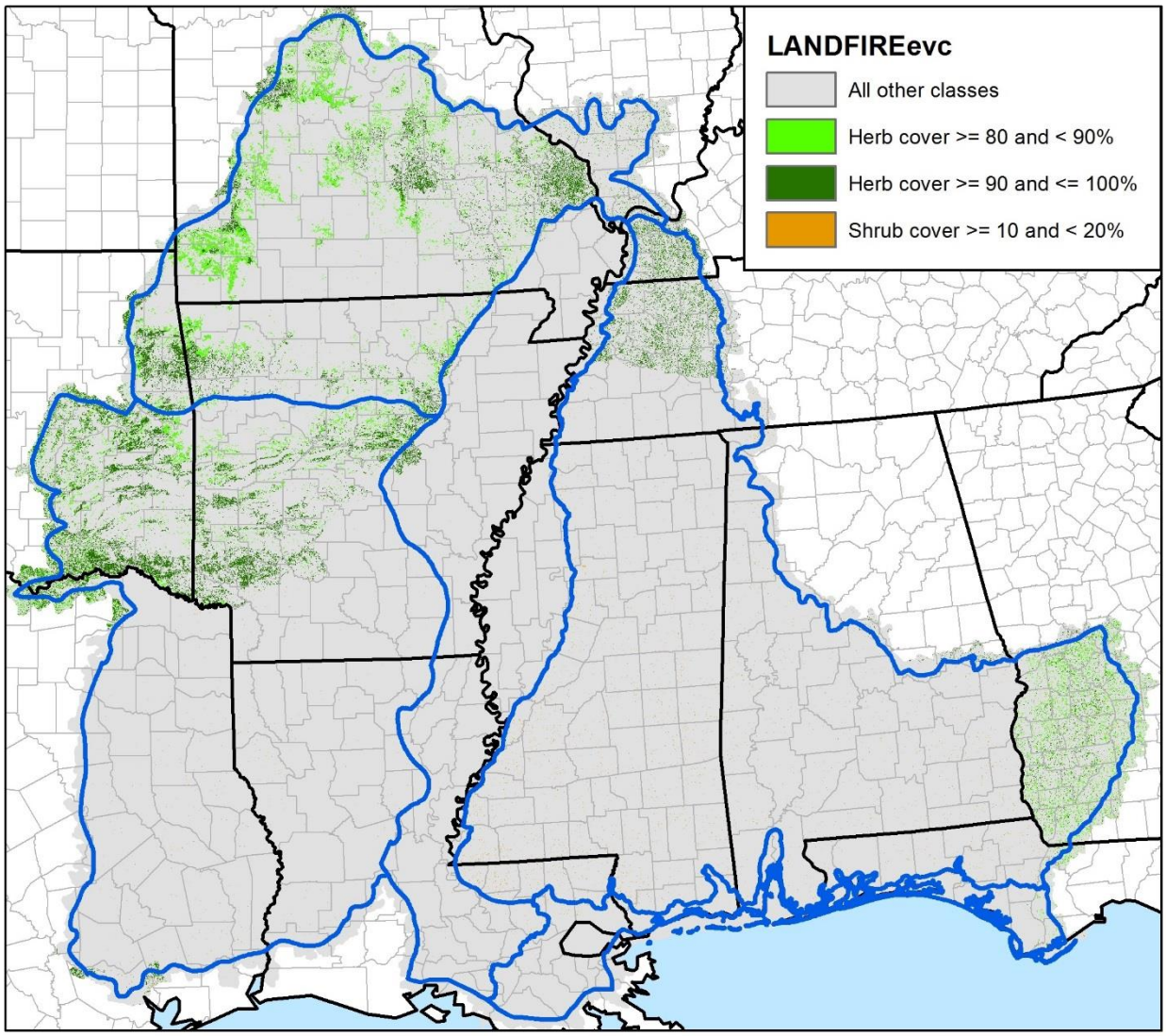

Figure 5: Raster image of selected LANDFIRE existing vegetation coverage classes in the GCPO, without regard to the grassland mask. Pixels of the shrub cover class, confined for the most part to the East Gulf Coastal Plain, are widely scattered and not visible at this scale.

This step resulted in a raster data layer in which each pixel described by LANDFIRE evc as herbaceous cover > 80% *or* shrub cover < 20%, and also described independently as part of the Grassland Mask, is given a value of 1 and all other pixels are given a value of 0.

Limitations:

LANDFIREevc class categories display seams at certain state boundaries, presumably due to bias resulting from variations in data collection methods. Use of the two highest percentage herbaceous cover classes in LANDFIREevc to assess bare ground implies that the remainder of the cover in the pixel is indeed bare ground. However, a rapid review of the literature on LANDFIREevc reveals no description of what the remainder might be. Also, by listing the bare ground and shrub cover endpoints separately, the ISA

indicates that the desired condition for large, dense, tall, and native grasses is that they be covered by *both* a minimum of 20% shrubs and a maximum of 20% bare ground. As a thematic, classified map, LANDFIRE necessarily describes the two conditions as mutually exclusive within pixels. A large landscape spatial data layer describing percent cover of multiple vegetation classes within pixels does not yet exist. Revisions of LANDFIRE are ongoing, and future assessments of these variables within grassland and other priority systems will be more accurate.

Surprisingly, LANDFIREevc describes very little land in Texas, Louisiana, Mississippi, or Alabama as having over 80% herbaceous cover, despite the fact that grasslands represented by LANDFIRE existing vegetation type (evt) are extensive in those states. LANDFIREevc herbaceous cover classes in most coastal plain states are described as being well below the 80% threshold used to address this endpoint (Figure 13).

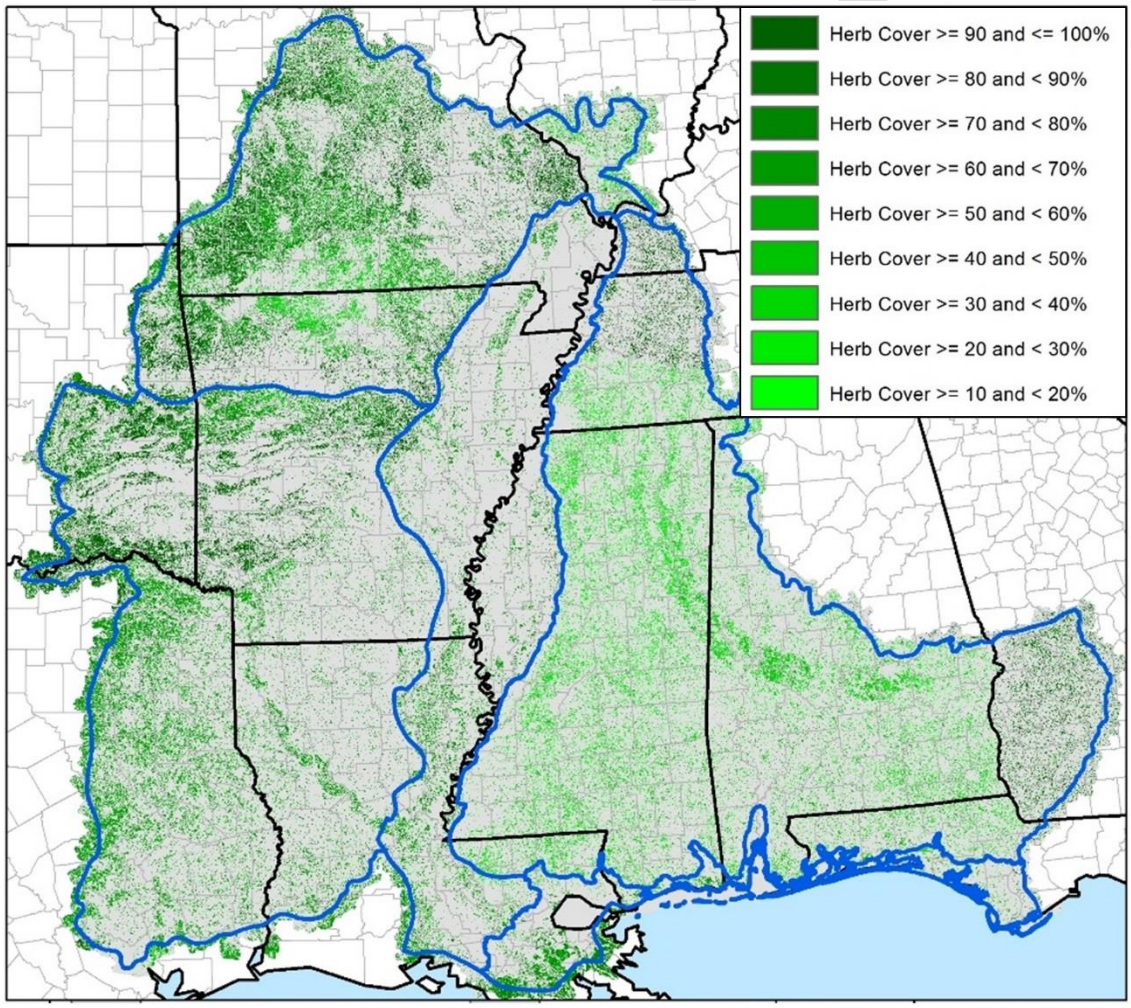

Figure 6: All LANDFIRE evc herbaceous classes in the GCPO, without regard to Grassland Mask.

<u>Tree density</u>
Metric: < 10/acre

Prairie and Savanna are generally described as grasslands where trees are either absent, widely scattered, or clustered in scattered groves. Attempts to classify prairie, woodland, and savanna by the amount of trees present rarely express a density metric. The presence of trees is typically addressed as percent overstory canopy, a metric that is more directly related to the amount of available photosynthically active radiation on the ground: lower values favor the mixture of heliophytic grasses and forbs common to prairies. Canopy cover values used to distinguish savanna from woodland vary in the literature, alternately presented as 30%, 40%, or sometimes 50% (Whilhelm 2004). Nelson (2011) describes prairies as having < 10% canopy cover and < 2 tress per acre, and savanna as having 10 – 30% canopy cover and < 5 trees per acre. The presence of some minimal number of trees, as opposed to none at all, creates a diversity of light environments, increasing species richness as ground flora species that prosper under partial shade co-occur with prairie species growing in more open areas (Dey and Kabrick 2015).

Tree density data was obtained from unpublished spatial data layers shared with GCPO staff by scientists at the USFS Remote Sensing Applications Center. These layers cover the 48 conterminous United States at a resolution of 250 meters and are derived from FIA surveys of forest health indicator variables. A layer describing tree density in grasslands was created by clipping the USFS Density of Live Trees layer to the GCPO with the Grassland Mask as the snap raster and resampling from 250 to 30 meters using the nearest neighbor procedure. No re-projection was necessary as the USFS layers are in NAD 1983 Albers, the common projection for this project. From the clipped, resampled raster, only those pixels with values <10 and in the Grassland Mask were selected. The resulting layer describes all pixels meeting both criteria: in the Grassland Mask, and tree density <10/acre, and is summarized as percentage of total cover per HUC12 watershed in figure 14, was used as an input in the generation of the condition index.

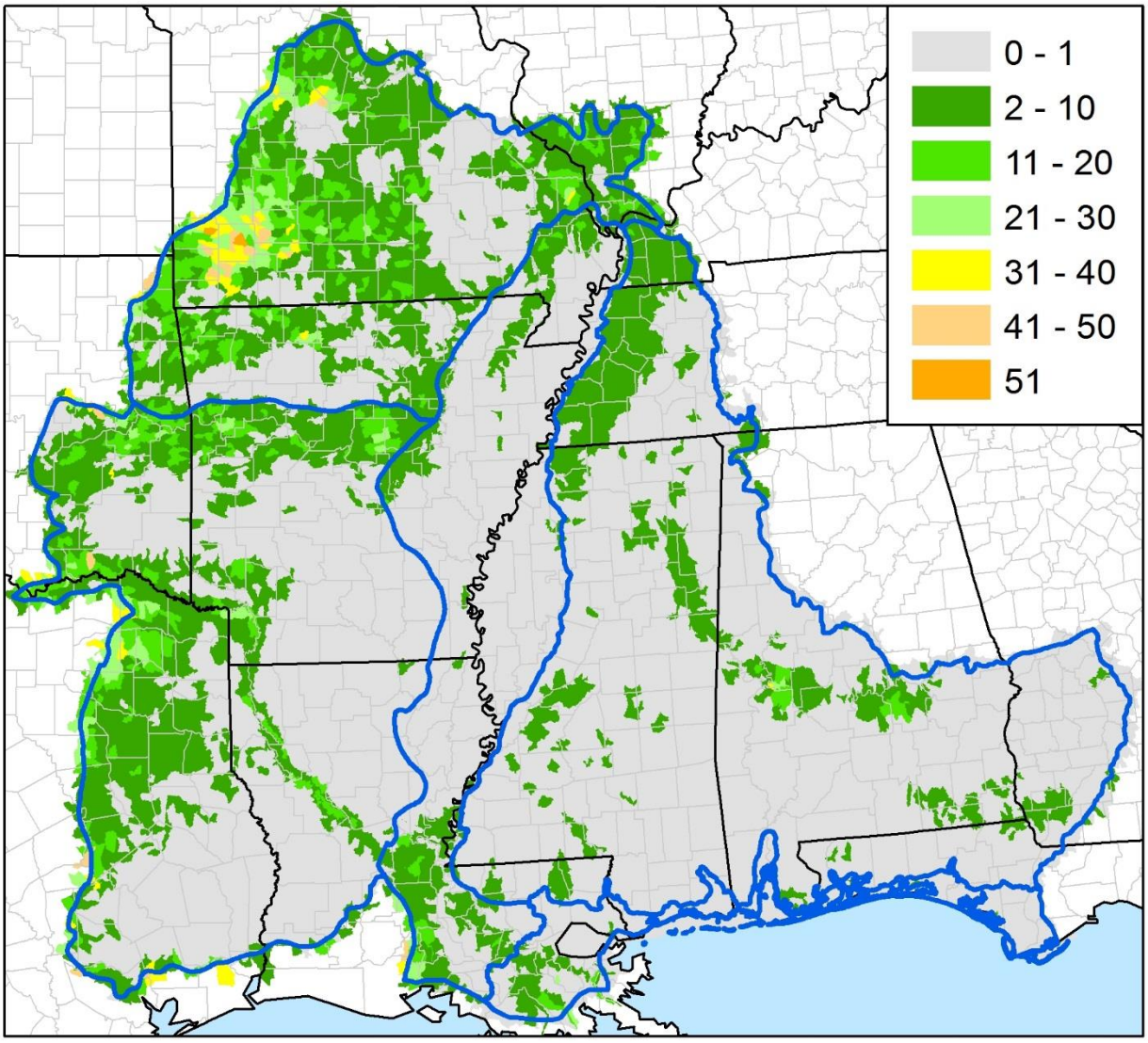

Figure 7: Land that is indicated as having tree density < 10/acre according to USFS/FIA, and is also described as a selected grassland type, according to LANDFIREevt and state-level inputs (Grassland Mask), summarized as percentage of total coverage in HUC12 watersheds.

This step resulted in a raster data layer in which each pixel described by the USFS/FIA data product as tree density, 10 trees/acre, and also described independently as part of the Grassland Mask, is given a value of 1 and all other pixels are given a value of 0.

Limitations:

Since grasslands are characterized by having few or no trees, we might assume that pixels described as grassland types by LANDFIRE evt and NASS CDL data layers have already been determined to be relatively treeless. On the other hand, confirmation that trees are absent or sparsely distributed by an independent data source strengthens the assessment. The USFS data layer used here is unpublished and at a coarser resolution (250 meters) than the other data layers. An alternative would be to use the publically available, 30 meter NLCD 2011 USFS Tree Canopy data layer. Doing so would require

establishing a percent canopy cover value (such as 10%) that corresponds to the tree density value of 10/acre as expressed in the ISA.

Disturbance return interval

Metric: A 5-year return interval on disturbance, with 20% of all grasslands disturbed annually

As a disturbance process effective in slowing or preventing natural succession, fire is important in grassland ecosystems, especially those situated in climates suitable for shrubs and trees (Anderson 2006, Axelrod 1985, Kline 1997). Soil disturbance also played a historical role in the system: areas affected by ant mound building, badger digging, and buffalo wallowing were colonized by short-lived weedy species such as horseweed and daisy fleabane, which established quickly and stabilized the soil. After fire, these weeds were replaced by long-lived prairie grasses, forbs, and legumes. After settlement, areas of disturbed soil (plowing) increased dramatically, while free-roaming fire decreased or disappeared (Kline 1997). No consensus exists on the periodicity of disturbance return in grasslands, and the metric is usually presented as a range (i. e. 3-7 years) rather than a single number. Species richness can be enhanced by avoiding predictable rotations. Managers should vary the season and the length of time between burns, because the prairie-savanna ecosystem developed in response to thousands of years of irregular disturbance patterns, and too much predictability may favor one set of plants and animals over another (Mierzwa 1997).

Data description

Disturbance return was assessed using the CONUS Vegetation Disturbance (LF 1.3.0) data product from LANDFIRE. These data use inputs from Landsat imagery and derived NBR (Normalized Burn Ratio) data, polygon and fire data from local agencies, and multiple other sources to provide temporal and spatial information related to vegetation disturbance over time. The data were collected during the period 1999-2012 and the resulting data layer contains attributes associated with disturbance rate of return, type, and severity.

Data processing

The Vegetation Disturbance data product features and attribute that describes the time since the disturbance measured in bins of one year, two to five years, and six to ten years. Although the longest of the three periods suggests an interval of greater than five years, we chose to include all time interval classes, since no single class positively attests to a land unit having been burned more than once during the period 1999 – 2012, only to the period of time between the disturbance and the collection of the data. The attribute associated with disturbance type includes the categories biological, chemical, development, fire, mechanical add, mechanical removal, no data, no disturbance, and windthrow. “Biological” refers to the use of living organisms, such as predators, parasites, and pathogens, to control weeds, pest insects, or diseases.

“Mechanical add” refers to mowing and “mechanical remove” refers to timber harvesting. From the set of pixels selected for the desired rate of return, we selected those pixels associated with disturbance types commonly associated with grassland and prairie conservation: chemical, fire, and mechanical add. The resulting data layer featured a selection of pixels associated with at least one occurrence of the selected disturbance types during the period 1999 - 2012. We restricted the selection further by extracting the disturbance layer through the Grassland Mask. The resulting layer was reclassified so that all pixels meeting the disturbance and the Grassland Mask criteria were given a value of 1, everything else 0, a layer summarized as percent cover by HUC12 watershed in Figure 15.

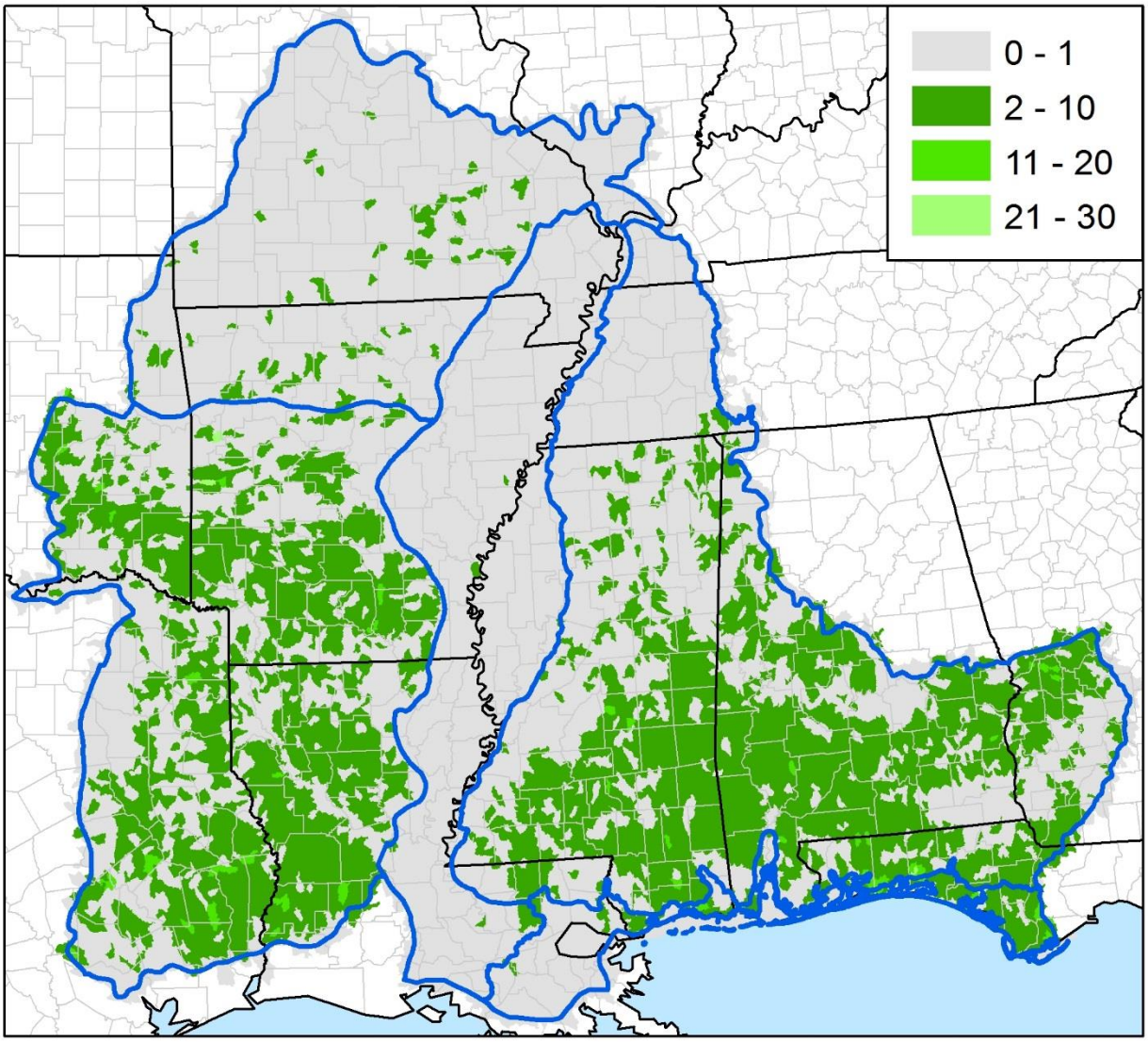

Figure 8: Land disturbed by fire, chemicals, or mowing at least once during the period 1999-2012 according to LANDFIRE’s vegetation disturbance layer, and also described as a selected

grassland type, according to LANDFIREevt and state-level inputs (Grassland Mask), summarized as percentage of total coverage in HUC12 watersheds.

This step resulted in a raster data layer in which each pixel described by LANDFIRE's vegetation disturbance layer as having been disturbed at a rate of at least once a year for 14 years, and also described independently as part of the Grassland Mask, is given a value of 1 and all other pixels are given a value of 0.

Limitations:
The Vegetation Disturbance data product used to assess this condition describes the location and type of disturbance but is not a true measure of the rate, a variable discussed in all grassland management literature. Going forward, understanding disturbance return at the large landscape scale will depend on a commitment to monitoring the practice at local units and on cooperation and communication across agencies and regions. Like vegetation height and cover, this endpoint is very difficult to monitor using products derived from remote sensing. The quality of future iterations of this important data product will depend on a broad based aggregation of regular and attentive data collection at the site level.

Results: A Map of the Grassland/Prairie/Savanna Condition Index

This process identified about 32 million acres of grassland habitat in the GCPO, about one million acres of which meets the narrower definition of prairie (Table 7). About 45% of the grasslands, or 14.5 million acres, are also characterized by the presence of at least one of the desired conditions described by the ancillary input layers. The presence of all four desired conditions occurs on only 3,388 acres of grassland in patches > 100 acres (Table 8). Most of these grassland pixels are found along the northwestern edge of the GCPO, where vegetation patterns transition to those of the tallgrass prairie of the Central Plains (Figure 17).

Table 7: Acreage amounts for each desired condition (columns) within each subgeography (rows) in the Grassland Mask

Subgeography	Grassland	Prairie	Potential	Height > 1m	Veg Cover >80 grass, <20% shrub	Tree Density < 10/acre	Disturbed in last 1-5 years
West Gulf Coastal Plain	11,505,453	355,349	917,764	478,517	2,753,746	1,575,786	1,201,609
East Gulf Coastal Plain	9,523,949	238,948	880,042	1,432,633	1,067,417	559,758	21,775
Mississippi Alluvial Valley	962,743	6,065	782,348	153,492	97,272	301,099	1,260,405
Ozark Highlands	9,770,677	324,683	2,832,766	161,437	3,368,713	2,235,495	105,304
Gulf Coast	424,565	121,040	79,049	115,017	16,057	49,822	108,403

TOTAL	32,187,387	1,046,085	5,491,969	2,341,096	7,303,206	4,721,959	2,697,495

Table 8: Acreage amounts for number of conditions met (rows) within categories of patch size and grassland type (columns) in the Grassland Mask

Number of endpoints met	Grassland < 100 acres	Grassland > 100 acres	Prairie < 100 acres	Prairie > 100 acres	TOTAL
0	8,190,382	11,193,715	545,892	338,883	20,268,872
1	3,886,379	7,975,286	576,349	375,755	12,813,769
2	692,945	1,930,342	5,252	23,752	2,652,292
3	2,341	11,657	18	81	14,097
4	0	0	0	0	0
TOTAL	12,772,048	21,111,000	1,127,511	738,470	35,749,029

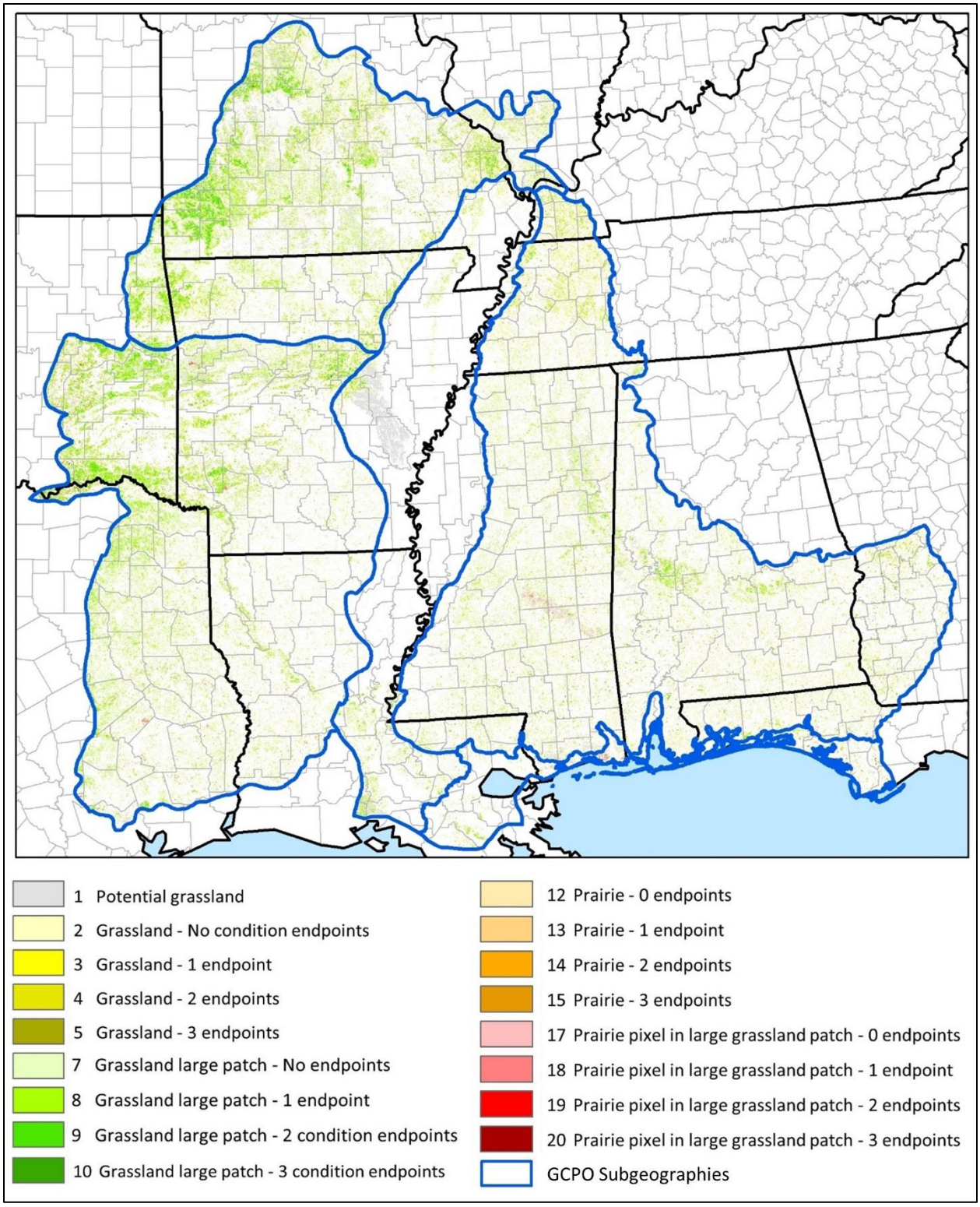

Figure 9: Grassland Condition Index data layer for the GCPO.

Prairie pixels (orange in Figure 17) are scattered widely throughout the Gulf Coastal Plains and Ozark Highlands, but aggregate to patches greater than a hundred acres (red) only in the Jackson Prairie Belt of Central Mississippi and in a few small sections

of the Ouachita Mountains in western Arkansas. Individual 30 meter pixels are not visible on maps reproduced at the size presented in this document. Of the prairie pixels, none featured four endpoints and the presence of 3 endpoints is indicated on only 18 acres. Acreage amounts by condition index score level are shown in Table 9.

Table 9: Acreage amounts for each condition index score

Score	Description	Acres
0	Non-habitat	139,296,652
1	Potential grassland	5,291,375
2	Grassland - No condition endpoints	8,190,382
3	Grassland - 1 endpoint	3,886,379
4	Grassland - 2 endpoints	692,945
5	Grassland - 3 endpoints	2,341
6	Grassland - 4 endpoints	0
7	Grassland large patch - No endpoints	11,193,715
8	Grassland large patch - 1 endpoint	7,975,286
9	Grassland large patch - 2 condition endpoints	1,930,342
10	Grassland large patch - 3 condition endpoints	11,657
11	Grassland large patch - 4 condition endpoints	0
12	Prairie - 0 endpoints	545,892
13	Prairie - 1 endpoint	576,349
14	Prairie - 2 endpoints	5,252
15	Prairie - 3 endpoints	18
16	Prairie - 4 endpoints	0
17	Prairie pixel in large grassland patch - 0 endpoints	338,883
18	Prairie pixel in large grassland patch - 1 endpoint	375,755
19	Prairie pixel in large grassland patch - 2 endpoints	23,752
20	Prairie pixel in large grassland patch - 3 endpoints	81
21	Prairie pixel in large grassland patch - 4 endpoints	0

The raster data layer includes a 9-digit barcode describing which endpoints contributed to the condition index score for each pixel, and is available for viewing and download in a gallery in the online Conservation Planning Atlas of the GCPO LCC (Table 10).

Table 10: Combination of endpoint contributions to the index value are described by a bar code and quantified by acres in the GCPO.

Index Value	Potential	Grassland Mask	Prairie Mask	Patch > 100 acres	Height >1m	Herb cover >80%	Tree Density < 10/acre	Disturbed at least once 1999 - 2012	Bar Code	Acres
1	1	0	00	0	0	0	0	0	100000000	6,359,980

Index Value	Potential	Grassland Mask	Prairie Mask	Patch > 100 acres	Height >1m	Herb cover >80%	Tree Density < 10/acre	Disturbed at least once 1999 - 2012	Bar Code	Acres
2	0	2	00	0	0	0	0	0	020000000	8,582,332
3	0	2	00	0	0	0	1	0	020000010	649,040
3	0	2	00	0	1	0	0	0	020001000	714,246
3	0	2	00	0	0	1	0	0	020000100	1,977,862
3	0	2	00	0	0	0	0	1	020000001	900,172
4	0	2	00	0	1	0	1	0	020001010	77,937
4	0	2	00	0	0	1	1	0	020000110	239,806
4	0	2	00	0	1	1	0	0	020001100	1,806
4	0	2	00	0	0	1	0	1	020000101	200,528
4	0	2	00	0	0	0	1	1	020000011	4,690
4	0	2	00	0	1	0	0	1	020001001	242,713
5	0	2	00	0	1	1	1	0	020001110	1,309
5	0	2	00	0	0	1	1	1	020000111	1,353
5	0	2	00	0	1	0	1	1	020001011	701
5	0	2	00	0	1	1	0	1	020001101	6
6	0	2	00	0	1	1	1	1	020001111	0
7	0	2	00	5	0	0	0	0	020050000	12,253,154
8	0	2	00	5	0	0	1	0	020050010	3,170,726
8	0	2	00	5	1	0	0	0	020051000	1,122,265
8	0	2	00	5	0	1	0	0	020050100	4,191,906
8	0	2	00	5	0	0	0	1	020050001	716,325
9	0	2	00	5	1	0	1	0	020051010	447,514
9	0	2	00	5	0	1	1	0	020050110	1,552,892
9	0	2	00	5	1	1	0	0	020051100	5,654
9	0	2	00	5	0	1	0	1	020050101	170,868
9	0	2	00	5	0	0	1	1	020050011	25,789
9	0	2	00	5	1	0	0	1	020051001	170,234
10	0	2	00	5	1	1	1	0	020051110	12,231
10	0	2	00	5	0	1	1	1	020050111	5,548
10	0	2	00	5	1	0	1	1	020051011	1,136
10	0	2	00	5	1	1	0	1	020051101	4
12	0	2	10	0	0	0	0	0	021000000	582,172
13	0	2	10	0	0	1	0	0	021000100	42,975
13	0	2	10	0	0	0	1	0	021000010	15,528
13	0	2	10	0	1	0	0	0	021001000	30,442
13	0	2	10	0	0	0	0	1	021000001	513,411
14	0	2	10	0	0	1	1	0	021000110	1,776
14	0	2	10	0	1	0	1	0	021001010	1,197

Index Value	Potential	Grassland Mask	Prairie Mask	Patch > 100 acres	Height >1m	Herb cover >80%	Tree Density < 10/acre	Disturbed at least once 1999 - 2012	Bar Code	Acres
14	0	2	10	0	0	1	0	1	021000101	395
14	0	2	10	0	1	1	0	0	021001100	77
14	0	2	10	0	0	0	1	1	021000011	1,131
14	0	2	10	0	1	0	0	1	021001001	1,306
15	0	2	10	0	1	1	1	0	021001110	2
15	0	2	10	0	0	1	1	1	021000111	6
15	0	2	10	0	1	0	1	1	021001011	11
15	0	2	10	0	1	1	0	1	021001101	2
17	0	2	10	5	0	0	0	0	021050000	413,472
18	0	2	10	5	1	0	0	0	021051000	20,000
18	0	2	10	5	0	0	1	0	021050010	50,553
18	0	2	10	5	0	1	0	0	021050100	152,631
18	0	2	10	5	0	0	0	1	021050001	246,974
19	0	2	10	5	1	0	1	0	021051010	2,549
19	0	2	10	5	0	1	1	0	021050110	36,330
19	0	2	10	5	0	1	0	1	021050101	1,126
19	0	2	10	5	0	0	1	1	021050011	3,832
19	0	2	10	5	1	1	0	0	021051100	70
19	0	2	10	5	1	0	0	1	021051001	2,115
20	0	2	10	5	1	1	1	0	021051110	6
20	0	2	10	5	0	1	1	1	021050111	49
20	0	2	10	5	1	0	1	1	021051011	27

Limitations and Future Directions

As is the case with the input layers used to generate the condition index, these spatial data products are designed to address regional landscape characteristics and are not intended to drive decisions at local scales. Spatial data layers presented here and on the GCPO LCC Conservation Planning Atlas were developed to support decision making at the scale of a county, watershed, national forest, or similar unit, and should never be used to make decisions at the scale of a single pixel or small group of pixels. Our analysis of how native prairie is described by NLCD 2102, NatureServe, GAP, and LANDFIRE evt, discussed earlier in this chapter, determined that LANDFIRE evt is the best option for parsing prairie from other grassland types in the GCPO. However, LANDFIRE evt is limited in this regard, and one noted limitation is the possible over-prediction of the amount of native prairie in the landscape in the Jackson Prairie Region of central Mississippi.

The condition input layers

The LANDFIRE and USFS spatial data layers used to address conditions within grasslands were generally developed to assess forests and fuels for wildfire. LANDFIRE revisions are ongoing, and communication with LANDFIRE staff at a GCPO LCC hosted geomatics coordination meeting in January 2016 in Jackson, Mississippi indicates that their organization is aware of the need for better geospatial data related to grasslands. Nevertheless, variables such as herbaceous height or herbaceous cover are very dynamic in large landscapes, as grasslands are either burned or mowed or as harvested managed forests regenerate. Ecological assessment of this system will continue to rely on a coordinated aggregation of site-level observations.

The Future of Region-Wide Grassland Conservation

State-level vegetation classification mapping products such as those developed for Texas, Oklahoma, and Florida, and regional scale ecological system mapping products such as the 2011 Update for the Eastern GCPO LCC are conceivably more reliable than national scale spatial data products for mapping native grasslands, being more attenuated to local variations in the spectral signatures of the relevant land classes. In the coming years, comprehensive geospatial data layers derived from LiDAR data will be more widely available, and these products provide better information regarding the height, density, and other features of the herbaceous layer than currently available products. Presently, truly reliable parsing of the various types of native grasslands and non-native herbaceous working lands such as pasture and harvested forest regeneration is problematic for any remote sensing-derived geospatial data product. The best, most reliable assessment of the amount and configuration (the *how much and where* question) of this priority system will continue to rely principally on aggregations of polygons of known, managed patches. Development of this knowledge will require cooperation across states by agencies and organizations, principally by Natural Heritage Programs, state departments of Natural Resources and Wildlife, Fisheries and Parks, initiatives such as The Black Belt Restoration Initiative, The Native Prairies Association of Texas, local groups such as Friends of the Black Belt Prairie, and others in the conservation community. Regional conservation of grasslands can also be improved by better communication with representatives of the CRP and EQIP practices and programs administered by USDA and NRCS. Presently no mechanism exists for understanding how these privately-owned grasslands, primarily field margins and stream buffers, interact ecologically and geospatially with the network of protected grasslands. The prairie-grassland-savanna system is characterized by relatively small, scattered and disjunct patches, a physical pattern reflected to some degree in the localized nature of the most active restoration efforts, a condition that could benefit from one principle mission of Landscape Conservation Cooperatives: to scale up and coordinate conservation efforts across agencies and states.

Appendix I: Selected Classes from GAP, NatureServe, and LANDFIRE evt used to create the Prairie Mask

Table 11: Selected classes from GAP, NatureServe, and Landfire evt used to create the Prairie Mask

	GAP	
Class value	Class Name	Acres
7313	Arkansas Valley Prairie and Woodland	12,937
7302	Central Mixedgrass Prairie	9
7315	Central Tallgrass Prairie	3,655
4108	East Gulf Coastal Plain Black Belt Calcareous Prairie and Woodland - Herbaceous Modifier	14,916
4303	East Gulf Coastal Plain Black Belt Calcareous Prairie and Woodland - Woodland Modifier	19,632
3302	East Gulf Coastal Plain Dry Chalk Bluff	679
7321	East Gulf Coastal Plain Jackson Prairie and Woodland	119
9603	East Gulf Coastal Plain Savanna and Wet Prairie	62,455
8408	Modified/Managed Southern Tall Grassland	196,136
5506	North-Central Interior Oak Savanna	21
7312	North-Central Interior Sand and Gravel Tallgrass Prairie	5
5507	North-Central Oak Barrens	4,122
8303	Recently burned grassland	224,230
7317	Southeastern Great Plains Tallgrass Prairie	27,257
7316	Texas Blackland Tallgrass Prairie	13,968
9604	Texas Saline Coastal Prairie	1,179
7505	Texas-Louisiana Coastal Prairie	6,456
5513	West Gulf Coastal Plain Catahoula Barrens	9,232
5514	West Gulf Coastal Plain Nepheline Syenite Glade	132
7319	West Gulf Coastal Plain Northern Calcareous Prairie	20,522
7320	West Gulf Coastal Plain Southern Calcareous Prairie	719,986
7309	Western Great Plains Sand Prairie	1
	TOTAL ACRES	1,337,650
	NatureServe	
7128	Arkansas Valley Prairie and Woodland	12,933
7134	Central Tallgrass Prairie	5,448
3117	East Gulf Coastal Plain Dry Chalk Bluff	679
9206	East Gulf Coastal Plain Savanna and Wet Prairie	48,040
7137	East-Central Texas Plains Xeric Sandyland	401
8516	Modified/Managed Southern Tall Grassland	864

8512	Recently Burned Forbland	582
2195	Recently Burned Herbaceous	118,855
5418	South-Central Saline Glade	237
7136	Southeastern Great Plains Tallgrass Prairie	24,010
7143	Southern Coastal Plain Blackland Prairie and Woodland	34,850
7135	Texas Blackland Tallgrass Prairie	128,234
9207	Texas Saline Coastal Prairie	670
7147	Texas-Louisiana Coastal Prairie	80,068
5419	West Gulf Coastal Plain Catahoula Barrens	9,393
5421	West Gulf Coastal Plain Nepheline Syenite Glade	132
7141	West Gulf Coastal Plain Northern Calcareous Prairie	20,459
7142	West Gulf Coastal Plain Southern Calcareous Prairie	513,821
5420	West Gulf Coastal Plain Weches Glade	8,413
7121	Western Great Plains Sand Prairie	1
	TOTAL ACRES	1,008,088
	LANDFIRE evt	
3415	Arkansas Valley Prairie and Woodland	105,164
3421	Central Tallgrass Prairie	5,262
3433	East Gulf Coastal Plain Jackson Prairie	20,555
3568	East Gulf Coastal Plain Jackson Prairie Woodland	81,063
3485	East Gulf Coastal Plain Savanna and Wet Prairie	57,355
3577	East Gulf Coastal Plain Wet Prairie Grassland	11,925
3578	East Gulf Coastal Plain Wet Prairie Shrubland	14,245
3539	Modified/Managed Northern Tallgrass Grassland	697
3540	Modified/Managed Southern Tallgrass Grassland	202,475
3394	North-Central Interior Oak Savanna	18
3412	North-Central Interior Sand and Gravel Tallgrass Prairie	1
3290	North-Central Oak Barrens Herbaceous	1,716
3418	Pennyroyal Karst Plain Prairie and Barrens	135
3195	Recently Burned-Herb and Grass Cover	671,730
3423	Southeastern Great Plains Tallgrass Prairie	273,843
3430	Southern Coastal Plain Blackland Prairie	44,462
3567	Southern Coastal Plain Blackland Prairie Woodland	35,409
3419	Southern Ridge and Valley Patch Prairie	849
3438	Tamaulipan Savanna Grassland	4
3422	Texas Blackland Tallgrass Prairie	6,337
3486	Texas Saline Coastal Prairie	471
3434	Texas-Louisiana Coastal Prairie	2,444
3403	West Gulf Coastal Plain Catahoula Barrens	8,119
3405	West Gulf Coastal Plain Nepheline Syenite Glade	141

3428	West Gulf Coastal Plain Northern Calcareous Prairie	7,904
3429	West Gulf Coastal Plain Southern Calcareous Prairie	109,289
3148	Western Great Plains Sand Prairie Grassland	124
3149	Western Great Plains Shortgrass Prairie	3
3416	Western Highland Rim Prairie and Barrens	766
	TOTAL ACRES	1,662,505

Appendix II: Detailed State-Level Contributions

Alabama

The crescent-shaped Black Belt of Alabama and Mississippi is the best known blackland prairie system (Noss 2013). This biologically and geologically distinct area extends from southwestern Tennessee south through east-central Mississippi and east to Russell county Alabama, near the Georgia border. Historically, scattered prairie patches occurred in a mosaic of hardwood and mixed hardwood/pine forests on weathered rolling plains overlaying a Cretaceous Selma chalk substrate (Schotz and Barbour 2009). General Land Office surveys from the 1830s show that approximately 356,000 acres of prairie patches of various sizes once existed, and these were noted and described by many seventeenth and eighteenth century observers (Barone 2005).

The Alabama Natural Heritage Program used expert and local knowledge, aerial photographs, topographic maps, and other GIS data to identify and map 14,595 individual prairie patches on 265 sites covering 15,509 acres (Schotz and Barbour 2009). The Alabama Natural Heritage program provided GCPO LCC staff with a shapefile associated with that assessment. These polygons were projected to NAD 1983 Albers and converted to raster data layers at 30 meter resolution to represent examples of observed prairie in Alabama.

Additional information about locations of prairies in Alabama obtained from Adelman and Schwartz (2013) is presented in Table 12. No polygons were generated from this information.

Table 12: Alabama prairies mentioned by Adelman and Schwartz 2013

County	Name	Acres	Notes
Autauga	Jones Bluff Park	539	Holds some Black Belt prairie. USACE Land. Park closed in 2005.
Dallas	Old Cahawba Prairie Tract	3007	Holds some Black Belt prairie and other grasslands. Owned by Alabama Forever Wild Land Trust.

Hale	State Cattle Ranch Tract	2031	Holds some Black Belt prairie and other grasslands. Owned by Alabama Forever Wild Land Trust.
Sumter	Old Bluff Port	32	Black Belt Prairie site managed by West Alabama University.

Arkansas

The Arkansas Natural Heritage Commission provided us with a shapefile of boundaries of their natural areas, tracts on which the Arkansas Natural Heritage Commission holds a restrictive conservation easement or fee title. We checked this data layer against Arkansas prairies described in Adelman and Schwartz (2013), the Protected Areas Database of the United States (PAD-US), and sites as described on the Arkansas Natural Heritage website. Through this process, 16 individual prairie patches totaling 7674 acres were identified and added to the state-level assessment (Table 13). Additionally, prairies noted as present in larger land units but not individually mapped (and therefore not included in the geospatial data layer) are listed in Table 14.

Table 13: Prairies in the Arkansas Natural Heritage Program and included in the geospatial data layer. *Note: NA = Natural Area, WMA = Wildlife Management Area*

County	Name	Acres
Arkansas	Roth Prairie NA	41
Ashley	Coffee Prairie NA	56
Benton	Chesney Prairie NA	83
Benton	Searles Prairie NA	10
Boone	Baker Prairie NA	71
Clark	Terre Noire NA	493
Cleveland	Kingsland Prairie NA	399
Franklin	Cherokee Prairie NA	584
Franklin	Flanagan Prairie NA	265
Franklin	Presson-Oglesby Preserve	155
Hempstead	Rick Evans Grandview Prairie WMA	4885
Howard	Saratoga Blackland Prairie NA	66
Miller	Miller County Sandhills NA	222
Prairie	Downs Prairie NA	24
Prairie	Konecny Prairie NA	70
Prairie	Railroad Prairie NA	250
TOTAL ACRES		7674

Table 14: Prairies Mentioned in Adelman and Schwartz 2013, not included in the geospatial data layer

County	Name	Acres	Notes

Ashley	Beryl Anthony / Lower Ouachita WMA	7500	Holds some prairie remnants
Bradley	Warren Prairie NA	4555	Holds some salt-slick barrens and saline prairies
Hempstead	Columbus Prairie	120	Blackland prairie. Part of Rick Evans Grandview WMA?
Hempstead	Nacatoch Ravines NA	2122	Holds some blackland prairie remnants
Little River	White Cliffs NA	573	Glades, Prairies, and woodlands protected by ANHC
Ouachita	Poison Springs State Forest Sand Barren	699	Holds some sandhill barrens and woodlands, supports sandhill grasslands
Prairie	Stuttgart Municipal Airport	2560	Important Bird Area (IBA) with some prairie-shrub habitat
Sebastian	Massard Prairie Battlefield Park	NA	Small, mowed city park. The only undeveloped part of a large prairie described by Thomas Nuttall in *A Journal of Travels into the Arkansas Territory During the Year 1819*
Washington	Woosley Wet Prairie Sanctuary	30	Restored wet tallgrass prairie and mounds
Washington	World Peace Wetland Prairie	3	Wet prairie remnant. A city-owned nature park in Fayetteville.

The selected Arkansas Natural Heritage Commission Natural Areas data layer was projected to NAD 1983 Albers and converted to a 30 meter raster layer to be processed as a state-level description of prairie in Arkansas.

Florida

Florida's best-known and most extensive prairies are found outside the GCPO. The only Florida prairie mentioned in Adelman and Schwartz (2013) within the GCPO boundary is the Perdido Pitcher Plant Prairie Project in Escambia County. No polygon representing the amount and configuration of the restored prairie was available.

A raster layer describing both grassland and prairie in within the GCPO boundary in Florida was derived from the Florida Land Cover Classification Scheme (Kawula 2009) which was developed in 2009 and revised in 2014 to meet the goals of that state's wildlife action plan. The Florida Fish and Wildlife Conservation Commission (FWC) and Florida Natural Areas Inventory (FNAI) compiled data from multiple sources to develop both vector and raster (10 meter resolution) versions of the geospatial data layer. The scheme hierarchy addresses land cover in three broad categories: upland, wetland, and exotic. The scheme uses the word "prairie" in ways that can be confusing. For example, Dry Prairie and Pine Flatwoods are combined in a single category that occupies about eight thousand acres within the GCPO. The scheme includes a

‘Flatwoods/Prairie/Marsh/Lake’ in the Lacustrine (land cover classes associated with lakes) category with a description devoted almost entirely to characteristics of the water, indicating that the system is neither flatwoods nor prairie but rather a kind of marsh/lake associated with those land cover classes. The description of ‘Palmetto Prairie’ states that saw palmetto is the “most dominant vegetation,” whereas Outcalt (2004) describes the ground cover as dominated by wiregrass (*Aristida beyrichiana*) with scattered saw palmetto. We selected six representative land cover classes from the Scheme accounting for 72,932 acres of natural prairie conditions in the portion of Florida covered by the GCPO (Table 15).

Table 15: Grassland land cover classes selected from the Florida Land Cover Classification Scheme. “FNAI” indicates that the classification schema was developed by the Florida Natural Areas Inventory. “FLUCCS” indicates the Florida Land Use Cover and Forms Classification System.

LC Name	LC #	Prairie?	acres	Description
Fallow Cropland	1833151		16,192	*No description given*
Improved Pasture	183313		160,573	This category in most cases is composed of land which has been cleared, tilled, reseeded with specific grass types and periodically improved with brush control and fertilizer application. Water ponds, troughs, feed bunkers and, in some cases, cow trails are evident. (FLUCCS)
Rural Open	1831		250,649	Herbaceous or shrubby vegetated areas in a rural setting. Ground typically appears improved or disturbed to some degree.
Seepage Slope	2114	x	3,866	On or at base of slope with loamy sand substrate; maintained by downslope seepage, usually saturated but rarely inundated; Panhandle and northern peninsula; frequent fire (1-3 years); dense herbaceous community; wiregrass, wiry beaksedges, flattened pipewort, toothache grass, pitcherplants. (FNAI)
Wet Prairie	2111	x	68,948	Flatland or slope with sand or clayey sand substrate; usually saturated but only occasionally inundated; statewide excluding extreme southern peninsula; frequent fire (2-3 years); treeless, dense herbaceous community with few shrubs; wiregrass, blue maidencane, cutthroat grass, wiry beaksedges, flattened pipewort, toothache grass, pitcher plants, coastal plain yellow-eyed grass. (FNAI)
Wiregrass Savanna	21111	x	2,655	Drier form of wet prairie; often dominated mainly by dense wiregrass with hydrophytic herbs common. (FNAI)

The data layer of selected Florida Land Cover classes was projected to NAD 1983 Albers and converted to a 30 meter raster layer to be processed as a state-level description of grassland and natural prairie in Florida.

Georgia

Calcareous or so-called “chalk” prairies can be found on high-pH, high shrink-swell clay soils of the Atlantic Coastal Plain, and one of the best examples is Oaky Woods Wildlife Management Area in Houston County (Georgia Department of Natural Resources), just outside the GCPO boundary. Most of the remnant prairies in this area are privately owned and in danger of being developed (Adelman and Schwartz 2013). All of Georgia’s calcareous prairies are outside of the GCPO geography, a fact confirmed by Nathan Klaus, a biologist with the Wildlife Resources’ Nongame Conservation Section of Georgia DNR. Klaus informed GCPO LCC staff that the only natural grasslands in the Gulf Coastal Plain area of Georgia are longleaf pine savannas. GCPO staff did not attempt to develop a catalogue of more general grassland types in Georgia.

Illinois

The Illinois Natural Areas Inventory (INAI) provides a set of information about high quality natural areas, habitats of endangered species, and other significant natural features in the state. The first survey of rare and or unique plants and animals in Illinois was conducted from 1975 to 1978 and documented nearly 1,100 sites on 25,000 acres. This was the first statewide natural areas inventory in the United States and was remarkable for a state with the size and complexity of Illinois (Illinois Natural Areas Update). The Inventory was extensively revised during the period from 2008 to 2011: Five hundred and twenty-five sites were re-visited, re-graded, re-mapped and quantitative vegetation data was collected (Illinois Natural Areas Inventory).

GCPO staff received a shapefile of polygons representing INAI sites in the thirteen Illinois counties that intersect our geography. Two fields in the attribute table of the INAI shapefile are relevant to the rapid ecological assessment: ‘SITENAME’ and ‘CATAGORIES’. Categories are defined as follows:

- Cat. I = High quality natural community and natural community restorations
- Cat. II = Specific suitable habitat for state-listed species or state-listed species relocations
- Cat. III = State dedicated Nature Preserves, Land and Water Reserves, and Natural Heritage Landmarks
- Cat. IV = Outstanding geological features
- Cat. V = Not used at this time
- Cat. VI = Unusual concentrations of flora or fauna and high quality streams

An additional file, “Communities,” was provided to the GCPO by INAI. “Communities” seems to be a subset of those INAI polygons designated as “Category I”. However, while in shapefile format, “Communities” seems to have been converted from a point file: every feature polygon is a circle of approximately eight acres in size. “Communities” has a community descriptor field (‘SCOMNAME’) in the attribute table which is useful in guiding a selection of prairie types from the INAI layer. In cases where a single named INAI site is comprised of multiple feature polygons, some confusion arises from not knowing whether the designated community descriptor applies to all features or the single one with which it corresponds spatially. There are five “Communities” features described as a prairie type in the descriptor field (Table 16)

Table 16: Five prairie types named in the INAI communities file

FEATURE_ID	SCOMNAME	Corresponding INAI Site Name
4686	Alkaline High Prairie, Midwest Type	Opposum Trot Trail
8774	Alkaline High Prairie, Midwest Type	Ozark Hills Prairies
9756	Alkaline High Prairie, Midwest Type	Pine Hills Annex
9060	Alkaline High Prairie, Midwest Type	Prairie du Rocher - South
9196	High Prairie, Midwest Type	Lake Murphysboro Hills Prairies

An additional INAI site, not included in the “Communities” file because it is a Category III, has the word “Prairie” in its name: Faulkner-Franke Railroad Prairie. Since the INAI shapefile contains no information about species or vegetative communities, site name is the only guide to distinguishing prairie from other types of land cover. So, in summary, six INAI sites have the word “prairie” in the site name, and five of those are identified as prairie by the community name field in the “Communities” shapefile.

The ESRI default aerial imagery basemap indicates that all of these sites are partially to entirely forested with the exception of the five acre Faulkner-Franke Railroad Prairie site. No INAI polygons were used in this assessment.

Adelman and Schwartz (2013) also mention the Ozark Hills and Lake Murphrysboro Hills sites, and add De Soto Prairie, a remnant on the right-of-way of Highway 51 in Jackson County, owned by Illinois Central Gulf Railroad and managed by Illinois Department of Natural Resources, and Larue Pine Hills / Otter Pond Research Natural Area, described as Loess hill prairie and limestone glades in Shawnee NF in Union County, to the list of prairie sites in the GCPO. We were unable to obtain polygons for these sites.

Kentucky

Kentucky features extensive grasslands on the Kentucky Karst Plain outside the northeastern boundary of the GCPO (Baskin et al 1999, Noss 2013). The Kentucky

State Nature Preserves Commission hosts a map entitled “Kentucky Then and Now,” which compares presettlement land cover with current conditions. This map indicates that prairie conditions once covered large areas of the eight westernmost counties that intersect the GCPO (Figure xx). So little remains that “prairie” is not included as a class in the map of current land cover.

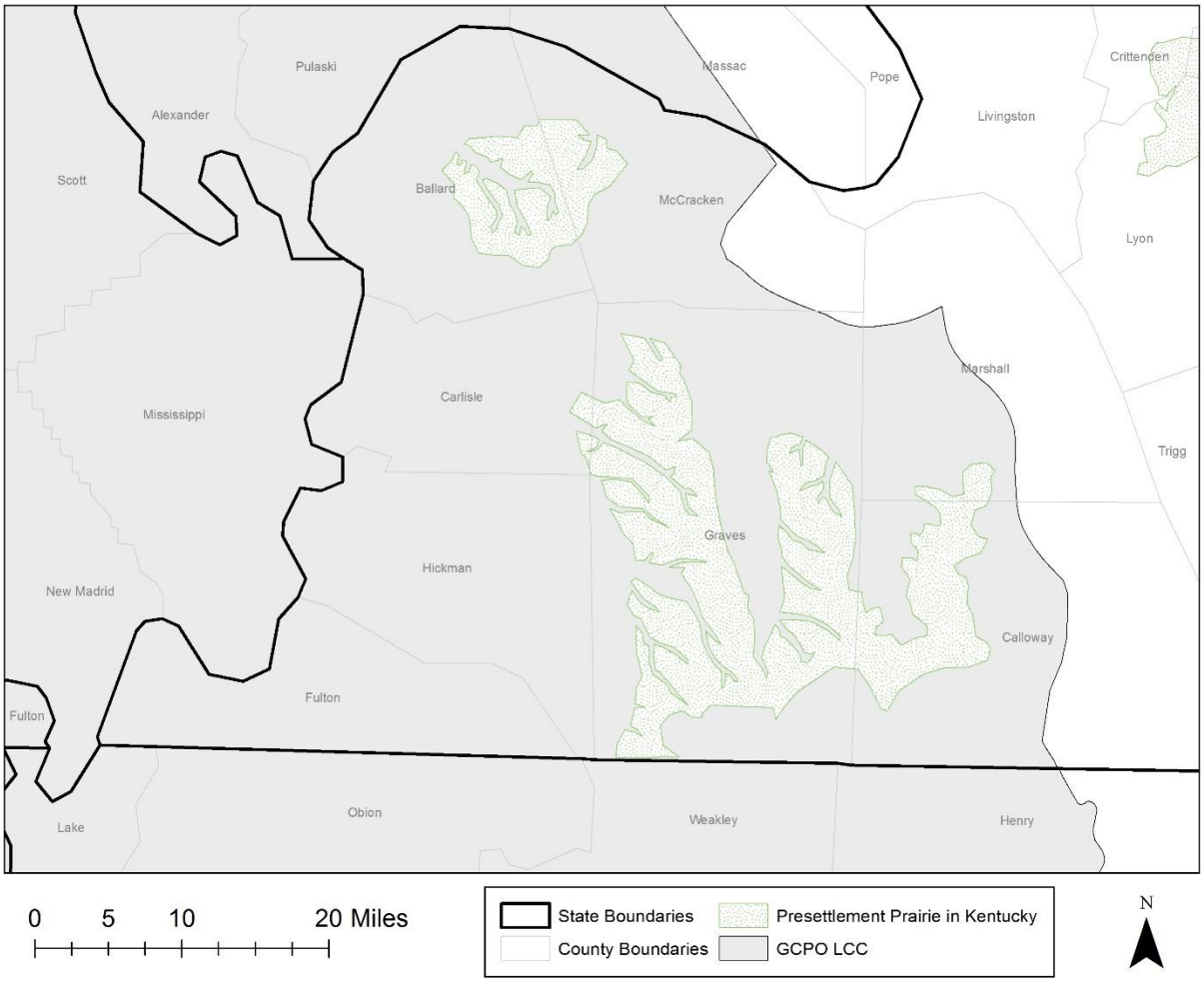

Figure 18: Presettlement prairie in western Kentucky, adapted from the map "Kentucky Then And Now," published by the Kentucky State Nature Preserves Commission

The Kentucky State Nature Preserves Commission website also hosts reports of threatened or endangered species by county. A review of reports for the eight counties in the GCPO indicates that a single grassland, classified as wet prairie, has been observed at Metropolis Lake Nature Preserve in McCracken County. We were unable to obtain geospatial data about this or any other prairie remnant in the area of Kentucky covered by the GCPO. Adelman and Schrawtz (2013) list no prairie sites in the eight Kentucky counties of the GCPO.

Louisiana

Coastal Prairie, informally known as 'Cajun Prairie,' once covered about 2.5 million acres of southwestern Louisiana, from the Atchafalaya bottomlands westward into Texas (Kimmel 2008), This area is covered by the Gulf Coastal Prairie Bird Conservation Region of the Gulf Coast Prairie LCC and crosses the southern boundary of the West Gulf Coastal Plain and the western boundary of the Mississippi Alluvial Valley subgeographies of the GCPO. Traveling through this area on horseback around 1870, Samuel Lockett described the prairies as "treeless expanses, covered with a luxuriant growth of grass," and "the most pleasing part of the state" (Lockett 1969). These prairies are characterized by poorly drained, dense clay subsoils and, in places, the presence of well-drained "pimple mounds," or "Mima mounds", 3 – 7 feet high and 30 – 40 feet in diameter, of unknown origin (Kimmel 2008, DeSelm and Murdock 1993). Today only about 1000 acres of Coastal Prairie remain.

North of the Coastal Prairie region, scattered prairies, barrens, and glades on calcareous soils in the uplands of the West Gulf Coastal Plain are noted by Noss (2013), DeSelm and Murdock (1993) and by LANDFIRE's biophysical settings layer West Gulf Coastal Plain Southern Calcareous Prairie. These prairies are not well-described in the literature.

According to the website for the Louisiana Natural Heritage Program (LNHP), the organization maintains a database on over 6,000 occurrences of rare, threatened and endangered species of plants and animals at 380 ecologically significant sites statewide. A detailed Element Occurrence Record (EOR), which includes precise locations, species population status, and habitat conditions and characteristics, is entered for each species occurrence in the LNHP Biological Conservation Database (BCD). After several conversations and emails, LNHP staff were unable to provide for the GCPO any geospatial data related to grasslands or prairies in Louisiana. A list of Louisiana prairie sites mentioned by a variety of sources is shown in Table 17.

Table 17: Louisiana Prairies from various sources. P&S = Peacock and Schauwecker 2003, A&S = Adelman and Schwartz 2013, N = Noss 2013, TNC = The Nature Conservancy, LNAR = Louisiana Natural Areas Registry

County	Name	Acres	Source	Note
Bossier	Barksdale Air Force Base	Unknown	P&S	"Morse clay prairies." Mentioned in the MacRoberts et al. chapter
Bossier	Bodcau WMA	34355	A&S	Holds some grasslands with typical prairie grasses
Caldwell	Copenhagen Hills Preserve	997	N, TNC, P&S, LNAR	Holds numerous calcareous prairie patches, including the named patch "Prairie du Cote."
Catahoula	Dewey Wills WMA	61871	A&S	Holds some grasslands with typical prairie grasses

Morehouse	Rector's Prairie	49	P&S, LNAR	Calcareous prairie. Registered Louisiana Natural Area
Rapides	Palustris Prairie	5	LNAR	Fleming prairie in Kisatchie NF. Registered Louisiana Natural Area
Winn	Carpenter Road Prairie	Unknown	N	A patch in the Kieffer Prairie complex
Winn	Kieffer Prairies	350	A&S, P&S, N	Scattered acres of prairie in the Winn district of Kisatchie NF. Tentatively classified as "bluestem prairies" Winn district also holds "Packton Prairies"

Mississippi

Prairies in Mississippi historically occurred in two belted formations: in the Black Belt of the northeastern part of the state on soils derived from the Late Cretaceous Demopolis chalk of the Selma group (Noss 2013), and in the Jackson Belt in the central part of the state on calcium-rich soils derived from Yazoo Clay of Eocene Age (Moran et al. 1997). Many patches were mapped by deputy surveyors of the General Land Office in the early decades of the nineteenth century (Barone 2005a, 2005b).

We obtained a shapefile of grassland projects on private land from the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP). These are boundaries of project areas where landowners are managing for grassland, primarily for dog trials or game bird species. These are not necessarily native prairies on native soils, although some are. This file also included the Black Prairie Wildlife Management Area, managed by MDWFP as grasslands in a variety of conditions.

We also obtained a shapefile of observed prairie locations from the Mississippi Natural Heritage Program (MNHP). One of the attribute table fields is labeled ‘BASIC_EO_R’ and contains the attributes ‘Excellent estimated viability,’ ‘Excellent or good estimated viability,’ ‘Extirpated,’ ‘Fair estimated viability,’ ‘Good estimated viability,’ ‘Good or fair estimated viability,’ ‘Poor estimated viability,’ and cells containing no attribute data. Using this field and aerial imagery, we examined those polygons described as ‘Extirpated,’ determined that they had indeed been converted to other land uses, and removed them.

We also removed a 3085-acre circular polygon in Noxubee County, Mississippi that featured a great variety of LANDFIREevt classes, dominated by pasture/hay, cropland, and developed classes. The Heritage Commission assigned the name “Blackbelt prairie (chalk bluffs)” to the polygon, but it appears to be the result of an analyst using an inappropriately large buffer tool on a point location.

The MDWFP and MNHP data layers were re-projected into NAD 1983 Albers and converted to 30 meter raster layers representing state-level descriptions of grassland and prairie respectively.

Named Mississippi prairie sites obtained from a variety of sources are listed in Table 18.

Table 18: Mississippi prairie sites from a variety of sources. A&S = Adelman and Schwartz 2013, C&S = Campbell and Seymour 2012, DS&M = Deselm and Murdock 1993, N = Noss 2013, P&S = Peacock and Schauwecker 2003.

County	Name	Acres	Source	Note
Chickasaw	Tombigbee National Forest	66000	A&S, N	Holds scattered blackbelt prairie patches
Chickasaw	Pulliam Prairie	250	C&S	High-quality Black Belt remnant
Lee	Chickasaw Village	Unknown	N	Archeological site and grassland with prairie plants on Natchez Trace Parkway in Tupelo
Lowndes	Blackland Prairie WMA	5000	A&S	Degraded blackland prairie in restoration
Newton	Eureka Church Prairie	1	A&S, P&S	Prairie remnant described in Moran et al. 1997
Oktibbeha	Osborn Prairie	140	A&S, P&S, N	Degraded Black Belt remnant
Pontotoc	Trace State Park	2500	A&S	Area of unknown size with cedar trees and semi-open prairie remnants.
Scott	Durand Oak Prairie	10	A&S, P&S	Prairie remnant described in Moran et al. 1997
Scott	Harrell Prairie Hill	200	A&S, N, P&S, DS&M	Bienville NF. Described by Moran et al. 1997
Smith	Five Acre Prairie	5	A&S, P&S	Prairie remnant described in Moran et al. 1997

Missouri

Most of Missouri, including northern portions of the Ozark Highlands in the GCPO, lies in the “prairie peninsula,” an ecological crossroads between the Great Plains of the West and the hardwood forests of the East (Adelman and Schwartz 2013, Transeau 1935). South of the prairie peninsula are numerous small, scattered glades and barrens, which have been classified and mapped through cooperative agreements between the US Forest Service and the American Bird Conservancy, with funding support by the Missouri Department of Natural Resources (MDNR) and the GCPO LCC. The Missouri glade distribution map classifies features by parent bedrock: dolomite, sandstone, limestone, igneous, and chert. The data layer can be found here. This rapid ecological assessment regards glades of the Ozark Highlands as separate from

Grassland/Prairie/Savanna, and these natural community types are not included in the map products or the condition index.

Missouri prairie locations were obtained by comparing prairie locations listed in Adelman and Schwartz (2103) to the Protected Areas Database of the United States (PAD-US), and a spatial data layer provided by the Missouri Prairie Foundation (MPF). This process resulted in the identification of 60 prairie locations within the GCPO boundary in Missouri, 18 of which were used to enhance the state-level contribution to the Prairie Mask (Table 19).

Table 19: Missouri Prairies in the GCPO. A&S = Adelman and Schwartz (2013), MPF = Missouri Prairie Foundation, MDC = Missouri Department of Conservation.

County	Name	Acres	Source	Polygon Used?	Notes
Barton	Golden Prairie	436	A&S, MPF	YES	Designated National Natural Landmark by NPS. Greater Prairie Chickens. On GCPO boundary.
Benton	Brinkly Hollow Conservation Area	186	A&S		Small glade, savanna, restored native grasslands
Benton	Hi Lonesome Prairie Conservation Area	655	A&S	YES	Virgin tallgrass prairie. Prairie mole cricket, greater prairie chickens.
Benton	Rock Hill Prairie	68	A&S		Holds native and restored prairie
Boone	Cedar Creek Trail	unknown	A&S		In Mark Twain National Forest. Croses large areas of prairie
Boone	Hinkson Woods Conservation Area	70	A&S		Holds a small restored prairie
Boone	Rock Bridge Memorial State Park	2273	A&S		Holds areas of restored native grasses
Boone	Rocky Fork Lakes Conservation Area	2025	A&S		Holds prairie, savanna, two old cemetaries
Boone	Three Creeks Conservation Area	1500	A&S		Holds glades and prairies, including glades mapped by ABC/MDNR
Callaway	Coats' Prairie	50	A&S		Reform Conservation Area. 10 acres of glades, 50 acres savanna, according to MDC. Includes glades mapped by ABC/MDNR
Camden	Ha Ha Tonka Savanna Natural Area	953	A&S		Within Ha Ha Tonka State Park, scattered oaks, prairie, rocky glades, savanna, and woodland
Camden	Toronto Springs Conservatin Area	568	A&S		Holds a small savanna
Cole	Runge Conservation Nature Center	107	A&S		Prairie restoration project in Jefferson City

County	Name	Acres	Source	Polygon Used?	Notes
Dade	Horse Creek Prairie Conservation Area	80	A&S		Remnant upland prairie
Dade	Indigo Prairie Conservation Area	40	A&S		Remnant upland prairie
Dade	Sloan Conservation Area	320	A&S		Grasslands and some native prairie
Dent	Wild River Trace Conservation Area	2044	A&S		Holds savanna, supports bobwhite quail
Dunkin	Morris State Park	161	A&S		Prairie remnant
Greene	Springfield Conservation Nature Center	80	A&S		Restored prairie, savanna, glade, inside Springfield City Limits
Henry	Chapel View Prairie Conservation Area	384	A&S		Mostly native prairie
Henry	Harry S. Truman Resevoir Management Lands (Leesville))	1808	A&S		Holds 612 acres of native prairie
Henry	Harry S. Truman Resevoir Management Lands (Upper Tebo Creek)	7409	A&S		Holds 700 acres of savanna
Henry	Montrose Conservation Area	2750	A&S		Holds a small native prairie
Hickory	Stark Family Prairie	34	MPF	YES	Bequeathed to MPF in 2013
Howell	Cover (Dan and Maureen) Prairie Conservation Area	736	A&S		Holds a savanna
Howell	Davidson-Paris Wildlife Area	270	A&S		Holds a savanna
Howell	Tingler Prairie Conservation Area	240	A&S		Holds remnant prairies, including 20-acre virgin prairie
Laclede	Bennet Springs Savanna	920	A&S		Holds savanna. Private conservation land
Laclede	Coleman Memorial Conservation Area	64	A&S		Holds restored prairie. South edge of Lebanon, MO, a small town.
Lawrence	Kickapoo Prairie Conservation Area	160	A&S	YES	Tallgrass prairie. Prairie mole cricket
Lawrence	Linden's Prairie	171	MPF	YES	Native prairie
Lawrence	Mount Vernon Prairie Natural Area	40	A&S	YES	Upland native dry prairie
Lawrence	Providence Prairie Conservation Area	197	A&S	YES	Large virgin prairie
Lawrence	Talbot Conservation Area	4113	A&S		Holds some native prairie and restored savanna

County	Name	Acres	Source	Polygon Used?	Notes
Lawrence	Woods Prairie Preserve	40	A&S		Virgin prairie restored by Ozark Regional Land Trust
McDonald	Big Sugar Creek State Park	2082	A&S		Some savanna
Mississippi	Towosahgy State Historic Site	64	A&S		Remains of Indian village built on prairie
Moniteau	Manito Lake Conservation Area	851	A&S		Holds some glades and prairie remnants
Montgomery	Grand Bluffs Conservation Area	223	A&S		Small remant hill prairie, savanna, and a small glade
Morgan	Hite Prairie Conservation Area	103	A&S	YES	Native tallgrass prairie
Newton	Diamond Grove Prairie Conservation Area	852	A&S	YES	802 acres of tallgrass prairie, including 570 acres of Diamond Grove Prairie Natural Area
Newton	George Washington Carver National Monument	210	A&S	YES	140 acre prairie restoration project
Pettis	Drover's Prairie Conservation Area	80	A&S, MPF	YES	Native Prairie
Pettis	Friendly Prairie Conservation Area	40	A&S, MPF	YES	Native Prairie
Pettis	Goodnight-Henry Prairie	40	A&S	YES	Private Conservation Land. TNC. Upland prairie
Pettis	Grandfather Prairie Conservation Area	80	A&S	YES	Native Prairie
Pettis	Paint Brush Prairie Conservation Area	310	A&S, MDC	YES	Native Prairie. Includes Paint Brush Prairie Natural Area
Phelps	Heilbrunn Prairie	32	A&S		Native Prairie in the Little Prairie Conservation Area
Polk	La Petite Gemme Prairie Natural Area	37	A&S, MPF	YES	Native Prairie
Polk	Twenty-five Mile Prairie Conservation Area	334	A&S	YES	Some native, some restored prairie
Reynolds	Grasshopper Hollow Natural Area	593	A&S		Contains the largest, most significant fen complex in un-glaciated North America. Adelman and Schwartz mention prairie as well but USFS, MDC, and TNC all just say fen. Jointly owned by the Mark Twain National Forest, The Nature Conservancy, and Doe Run Mineral Corporation.
Scott	Sand Prairie Conservation Area	200	A&S	YES	Restored prairie
St. Clair	Harry S. Truman Reservoir Management	5375	A&S		Holds a native prairie on HWY 82 southwest of Osceola

County	Name	Acres	Source	Polygon Used?	Notes
	Lands (Sac-Osage)				
St. Francois	St. Francois State Park	2734	A&S		Holds wet meadows and fens
St. Francois	St. Joe State Park	8243	A&S		Holds savanna and a prairie located at 2800 Pimville Rd., Park Hills
Taney	Boston Ferry Conservation Area	181	A&S		Holds a small native prairie
Taney	Hercules Glade Wilderness Area	12315	A&S		Holds prairie grassland, tallgrass prairie, and glades
Texas	Gist Ranch Conservation Area	11204	A&S		Holds some fens, glades, and savanna
Washington	Washington State Park	2147	A&S		Holds some savanna
Wayne	Coldwater Conservation Area	10737	A&S		Holds some savanna

Oklahoma

We reviewed classes from the Oklahoma Ecological Systems Mapping Project based on descriptions in the Interpretive Booklet. Twelve ecological system names include the terms “prairie,” “grassland,” or “pasture.” A review of their brief descriptions indicates that, while all of them can be considered grasslands, none are described as being dominated by native vegetation (Table 20).

Table 20: Grasslands described in the Oklahoma Systems Mapping Project

Value	Name	Brief Description
14407	Arkansas Valley: Prairie/Pasture	This type circumscribes a variety of grasslands. In the modern landscape, non-native and grazing-tolerant species such as Bermudagrass, field brome, marsh bristlegrass, thickspike tridens, and tall fescue are common components. Some native hay meadows or lightly grazed native sod may be dominated by native prairie species such as little bluestem, switchgrass, yellow Indiangrass, and big bluestem.
14417	Arkansas Valley: Sandy Prairie/Pasture	This type occurs over more or less deep sands of the Arkansas River valley in far eastern Oklahoma, and consists mainly of grazed pastures in the modern landscape, although some areas of native hay and disturbed sands near the river also occur. Common components include Bermudagrass, field borne, thickspike tridens, and silver bluestem. Native hay meadows have species such as big bluestem, switchgrass, little bluestem, and yellow Indiangrass.
207	Blackland: Pasture/Prairie	In the modern landscape this type is most often represented by heavily grazed pasture dominated by non-native and grazing tolerate species such as Bermudagrass, field brome, and tall fescue. Areas with lower levels of grazing may have species such as little bluestem, yellow Indiangrass, and big bluestem among the dominants.
507	Crosstimbers: Pasture/Prairie	This type is mapped essentially from the southern border to the northern border of Oklahoma, and across the east to west extent of the

Value	Name	Brief Description
		Crosstimbers and transition zone to central Oklahoma. In the modern landscape, non-native and grazing-tolerant species dominate most areas. Common species include Bermudagrass, field brome, western (Cuman) ragweed, and tall fescue. More lightly-grazed areas or hay meadows may have species such as little bluestem, silver bluestem, switchgrass, big bluestem, sideoats grama, and yellow Indiangrass. Woody species such as post oak, pecan, blackjack oak, winged elm, eastern redcedar, honeylocust, Osage orange, and common persimmon may be components.
526	Crosstimbers: Sandyland Shrubland and Grassland	This type is mapped over more or less deep sands and in the modern landscape if most often represented by grazed pasture with non-native and grazing-tolerant species such as Bermudagrass, tall fescue, annual ragweed, weeping lovegrass, Johnsongrass, and sandbur species. Overall herbaceous species diversity tends to be fairly high over deeper sand, and some may contain species such as little bluestem, pinweed, Florida snake-cotton, southern jointweed, and Alabama supplejack. Common woody components include Chickasaw plum, post oak, winged elm, and blackjack oak.
9327	Disturbed Soil Pasture	This type is mapped over soils defined as disturbed by digital soil surveys (e.g. slickspots, pits). Non-native and disturbance species such as Bermudagrass, tall fescue, Johnsongrass, winged elm, and honeylocust are common components.
2027	Osage Plains: Tallgrass Prairie/Pasture	This type circumscribes a variety of mainly grazed grasslands, but some native hay meadows are also represented. In the modern landscape, non-native and grazing-tolerant species such as Bermudagrass, tall fescue, field brome, western (Cuman) ragweed, prairie broomweed, and sericea lespedeza are common. Some areas have native tallgrass elements such as little bluestem, switchgrass, big bluestem, heath aster, and Canada goldenrod. Woody elements may include common persimmon, eastern redcedar, sugar hackberry, elm species, and honeylocust.
9117	Ozark-Ouachita: Pasture/Prairie	This type circumscribes broad variation, but in the modern landscape most representatives are grazed pastures. Common species are non-native and grazing tolerant grasses and forbs such as Bermudagrass, tall fescue, annual ragweed, field brome, purpletop tridens, sericea lespedeza, prairie broomweed, and sneezeweed. Less heavily grazed areas may support grasslands with species such as little bluestem, big bluestem, and yellow Indiangrass. Woody species such as post oak, black walnut, common persimmon, winged elm, sumac species, and eastern redcedar may be components.
607	Post Oak Savanna: Pasture/Grassland	This type is mainly represented by grazed pastures dominated by non-native and grazing-tolerant species in the modern landscape. Common components include Bermudagrass, field brome, tall fescue, western (Cuman) ragweed, purpletop tridens, and silver bluestem. Woody components may include post oak, winged elm, Osage orange, pecan, honeylocust, water oak, and eastern redcedar.
617	Post Oak Savanna: Sandyland Shrubland and Grassland	This type is mapped over more or less deep sands and in the modern landscape if most often characterized by grazed pasture with non-native and grazing-tolerant species such as Bermudagrass, tall fescue, annual ragweed, and sandbur species. Some areas with deeper sands may contain species such as little bluestem, Florida snake-cotton, pinweed, southern jointweed, and Alabama supplejack. Vines such as eastern poison ivy and greenbriar species are common.

Value	Name	Brief Description
14307	West Gulf Coastal Plain: Northern Calcareous Prairie/Pasture	This type is mainly represented by grazed pastures with non-native and grazing-tolerant species in the modern landscape. Common species may include Bermudagrass, prairie broomweed, field brome, western (Cuman) ragweed, and Johnsongrass. Woody species such as winged elm, sumac species, possumhaw, and sugar hackberry may be present.
9197	West Gulf Coastal Plain: Pasture	This type is mainly represented by grazed pastures with non-native and grazing-tolerant species in the modern landscape. Common species may include Bermudagrass, little bluestem, prairie broomweed, prairie tea, tall fescue, field brome, and Johnsongrass. Woody species may include winged elm, sugar hackberry, possumhaw, green ash, and eastern redcedar.

We used these 12 classes to indicate the presence of grassland (but not the more restrictive definition of prairie) in Oklahoma. The data layer was projected to NAD 1983 Albers, reclassified to include the 12 classes, then resampled from 10 meter to 30 meter resolution using the 'Nearest' technique and the LANDFIREevt layer as the processing extent and snap raster.

Tennessee

Most Tennessee grasslands are found in the limestone glades and rocky barrens of the Central Basin, Cumberland Plateau, and Ridge and Valley regions of the state, outside of the GCPO (Noss 2013, DeSelm and Murdock 1993). Within the Gulf Coastal Plain, Transeau (1935) mapped presettlement prairies in Weakley, Henry, and Gibson Counties, which he regarded as outliers of the Prairie Peninsula, a wedge-shaped or peninsula-like extension of western grasslands eastward into Illinois, Indiana, and Ohio, bounded by forests to the North, East, and South.

GCPO Staff contacted staff at the Tennessee Department of Environment and Conservation, The Nature Conservancy, and the Tennessee Wildlife Resources Agency (TWRA), but were unable to obtain any geospatial data related to grassland/savanna/prairie systems in Tennessee. Annual reports on Wildlife Management Areas provided by TWRA indicate acres of "old field." These amounts aggregate to almost eight thousand acres (Table 21).

Table 21: Acres of "Old Field" described in annual reports obtained from the Tennessee Wildlife Resources Agency.

Wildlife Management Area	Acres 'Old Field'
John Tully	125
Wolf River	1303
Three Rivers	75
Chickasaw State Forest	828
Black Bayou Refuge	17
Reelfoot	29

Thorny Cypress	1936
Tumbleweed	1200
Gooch	20
Maness	51
Moss Island	534
Horns Bluff Refuge	90
Hop-in Refuge	4
Obion River	79
Bean Switch Refuge	42
Jarrell Switch Refuge	4
Bogota	940
Ernest Rice	170
White Lake Refuge	162
Tigrett	310
TOTAL	**7919**

Several contacts urged us to consider Ames Plantation in Fayette and Hardeman Counties, site of the Bird Dog Field Trial National Championship every year since 1915. Accounts vary as to how much grassland exists at Ames Plantation, and no georeferenced map is available.

With no reliable state-level geospatial data representing either the more general class of grassland or the more restrictive class of prairie in Tennessee, our Grassland-Prairie-Savanna condition index map relies on selected classes from LANDFIREevt alone to represent this state.

Texas

The Texas Blackland Prairies Ecoregion (EPA Level III) lies mostly to the west of the GCPO, intersecting the western boundary in a few places (U. S. Environmental Protection Agency 2013). The LANDFIRE BpS data layer, which represents vegetation that may have been dominant on the landscape at the time of European settlement, maps about 275,000 acres of Texas Blackland Prairie in large contiguous patches along the boundary. LANDFIRE's evt layer, representing present day conditions, maps only 6337 acres of the system, restricted to the land adjacent to the floodplain of the Red River, which forms the border between Texas and Oklahoma. NatureServe describes Texas Blackland Tallgrass Prairie as characterized by the presence of dark alkaline Vertisol soils over calcareous parent material, found primarily in the Texas Blackland Prairies Ecoregion but also ranging into southern Oklahoma (NatureServe 2015).

Other potential natural grassland types indicated by LANDFIRE BpS for the Texas portion of the WGCP include Southeastern Great Plains Tallgrass Prairie and small amounts of Central Mixedgrass Prairie and Western Great Plains Sand Prairie. The

data layer also indicates the potential for numerous small, scattered patches of Southern Calcareous Prairie across the south-central part of the WGCP into Louisiana, and large contiguous patches of Texas-Louisiana Coastal Prairie along the southern boundary of the WGCP. LANDFIRE evt and NatureServe also recognize variations of the rarer Saline Prairie, occurring in floodplains on soils of relatively high salinity, and NatureServe adds numerous patches of Weches Glade, endemic to outcrops of marine sediment and glauconitic clays of the Weches Formation, in Nacogdoches County, on land classified by LANDFIRE evt as primarily pasture/hay. Another rare prairie type is the Fleming Prairies, on deep clay calcareous soils following the narrow arc of the Fleming Formation, which runs from just west of Huntsville, through Jasper, to Burkeville on the Texas-Louisiana state line (Singhurst 2009). Mentions of specific locations of prairies in the WGCP in Texas, compiled from various sources, are listed in Table 22. Of those listed, only one, Marysee Prairie Preserve in Liberty County, was found to have an associated polygon in the PADUS 1.4 data layer that could be used in the state-level contribution to the Prairie Mask.

Table 22: Known prairie locations in the Texas part of the GCPO. A&S = Adelman and Schwartz 2013, NPAT = Native Prairies Association of Texas, S = Singhurst 2009.

County	Name	Acres	Source	Note
Anderson	Rusk and Palestine Parks	136	A&S	Holds some priarie
Bowie	Mary Talbot Prairie	115	NPAT	Rare Silveus' Dropseed Prairie, a prarie type named for the dominant grass and found on relatively sandy and acidic soil
Cherokee	Caddo Mound State Historic Site	100	A&S	Holds some prairie
Fannin	Caddo National Grasslands	17785	A&S	Some grasslands, some oak savannas
Hardin	Big Thicket National Preserve	96750	A&S	Holds some prairie and some oak savannas
Lamar	Pat Mayse Wildlife Management Area	8925	A&S	Holds tallgrass prairie and oak savanna
Liberty	Marysee Prairie Preserve	9	A&S	Native coastal prairie
San Jacinto	Oakhurst Prairie	Unknown	S	Owned by Weyerhaueser and cooperatively managed by the Land Incentive Program
San Jacinto	Russell Grasslands and Forest Preserve	831	NPAT	Holds some pocket prairies and Catahoula barrens surrounded by pine, hardwood, and bottomland forest.

County	Name	Acres	Source	Note
Smith	Smith County Nature Center	82	A&S	Holds some prairie
Tyler	Chester Prairie	1700	S	Conservation area owned by Campbell Timber. A Fleming prairie
Tyler	Colmesneil Prairie	100	S	Owned by Hancock Forest Management
Wood	Edmoore Creek	392	NPAT	Backwater swamp that supports a mixed bottomland hardwood, shrub swamp, and open meadow complex.

In addition to the 9-acre Marysee Prairie Preserve, additional contributions to the Grassland-Prairie Masks in Texas were developed by selecting classes from the Texas Ecological Systems Classification project based on descriptions in the interpretive booklet (Ludeke et al 2009). System descriptions that emphasize the presence of nonnative vegetation were considered grasslands but not prairies. Descriptions that emphasize native vegetation were selected for the more restrictive category of prairie (Table 23).

Table 23: Grasslands described in the Texas Ecological Systems Classification project.

TEXAS NAME	Prairie	Description
Blackland Prairie: Disturbance or Tame Grassland		This type includes grasslands in many conditions, and introduced Bermudagrass and King Ranch bluestem are often important components. Little bluestem, silver bluestem, broomsedge bluestem, threeawns, common broomweed, western ragweed, and hog croton are common components, Shrubs or sparse tree cover including plateau live oak, post oak, eastern redcedar, mesquite, huisache, yaupon, and winged elm may also be present.
Central Texas: Floodplain Herbaceous Vegetation		A variety of generally tame or successional grasslands and forblands are mapped in this type, with Bermudagrass, Johnsongrass, and Bahia grass all common. Successional forbs such as hog croton and giant ragweed are also common.
Central Texas: Riparian Herbaceous Vegetation		These areas are characterized by managed pastures in a variety of conditions, and may contain species such as Bermudagrass, Johnsongrass, little bluestem, western ragweed, common broomweed, Virginia wildrye, and Texas wintergrass.

TEXAS NAME	Prairie	Description
Crosstimbers: Savanna Grassland		This type includes grassland in many different conditions, including areas dominated by non-native Bermuda grass and King Ranch bluestem with grazing-tolerant forbs such as broomweed and western ragweed, as well as areas with native species such as little bluestem, Texas wintergrass, Indiangrass, silver bluestem, and sideoats grama. Mesquite is a common shrub, and this mapped type may include some areas with fairly dense mesquite cover.
Edwards Plateau: Savanna Grassland		Grassland condition varies for this mapped type, but many areas contain non-native King Ranch bluestem as an important species, and Bermuda grass is also frequent. Common native grasses include little bluestem, sideoats grama, silver bluestem, Texas wintergrass, purple three-awn, and common curlymesquite. Trees and shrubs are usually present, and may include plateau live oak, Ashe juniper, mesquite, agarito or cedar elm. Shrub cover may be dense enough to qualify as shrubland rather than grassland in some areas.
Grass Farm		Areas mapped as this type include moist soils with fastgrowing grasses, golf courses, and managed hay meadows with Bahia grass, Bermudagrass, or Johnsongrass.
Gulf Coast: Coastal Prairie		A variety of grasslands are circumscribed by this mapped type, and species such as Bermudagrass, Bahia grass, rat-tail smutgrass, broomsedge bluestem, busy bluestem, brownseed paspalum, and little bluestem may be dominant. Shrubs such as baccharis, Chinese tallow, or mesquite may be present.
Gulf Coast: Salty Prairie	x	Gulf cordgrass may form nearly pure stands within this mapped type, or may form mosaics with marshhay cordgrass or saltgrass at slightly lower elevations. Other common grasses include Gulf muhly, switchgrass, and bushy bluestem, and shrubs such as baccharis or bigleaf sumpweed may also occur.
Pineywoods: Bottomland Wet Prairie		Introduced grasses such as Bermudagrass, Bahia grass, and Johnsongrass may dominate many areas of this mapped type, and natives such as broomsedge bluestem, bushy bluestem, switchgrass, little bluestem, and Florida paspalum may be important in some areas. Common sparse woody cover may include black willow, wax-myrtle, common buttonbush, sweetgum, red maple, and water oak.

TEXAS NAME	Prairie	Description
Pineywoods: Catahoula Herbaceous Barrens	x	This mapped type occurs over soils that may vary in depth across small areas. Important species, depending on soil depth, may include Nuttall's rayless golden-rod, poverty dropseed, poverty threeawn, little bluestem, broomsedge bluestem, and Silveus' dropseed. Post oak, blackjack oak, and pines (longleaf, shortleaf) may form a sparse overstory.
Pineywoods: Disturbance or Tame Grassland		This mapped type includes many areas dominated by introduced species such as Bermudagrass, Bahia grass, and Johnsongrass. Important components may also include little bluestem, broomsedge bluestem, and hog croton, as well as shrubs such as yaupon and southern dewberry and sparse trees such as post oak and loblolly pine.
Pineywoods: Saline Glade	x	This mapped type occurs over soils that vary in salinity across small areas, and may include sparse woodlands and shrublands as well as herbaceous vegetation. Post oak, blackjack oak, baccharis, and narrowleaf sumpweed may be important woody species. Three-awns, saltgrass, and spikerushes and other sedges may occur in the herbaceous layer.
Pineywoods: Sandhill Grassland or Shrubland	x	Little bluestem often shares dominance with shrubs and small trees such as post oak, blackjack oak, bluejack oak, southern red oak, sweetgum, black hickory, and eastern redbud within this ridge and hilltop mapped type. On the deepest sands, species most common on, or endemic to, sands such as narrowleaf pinweed, cardinal's feather, rattlesnake flower, Carrizo Sands woollywhite, and showy nerve-ray may be components.
Pineywoods: Small Stream and Riparian Herbaceous Wetland	x	A variety of herbaceous vegetation on floodplains occurs within this mapped type. Sedges, rushes, and other wetland species may dominate, and drier areas may support little bluestem, broomsedge bluestem, bushy bluestem, or introduced grasses such as Johnsongrass, Bermudagrass, and Bahia grass (south). Shrubs and small trees may include black willow, wax-myrtle, common buttonbush, and sweetgum.

TEXAS NAME	Prairie	Description
Pineywoods: Small Stream and Riparian Wet Prairie		Introduced grasses such as Bermudagrass, Bahia grass, and Johnsongrass may dominate many areas of this mapped type, and natives such as broomsedge bluestem, bushy bluestem, switchgrass, little bluestem, and Florida paspalum may be important in some areas. Common sparse woody cover may include black willow, wax-myrtle, common buttonbush, sweetgum, red maple, and water oak.
Pineywoods: Southern Calcareous Mixedgrass Prairie	x	This mapped type represents grasslands in a variety of conditions, and important species may include Bermudagrass, little bluestem, sideoats grama, broomsedge bluestem, Texas wintergrass, gramas, and threeawns. Forbs such as snow-on-the-prairie, yellow neptunia, prairie acacia, and scarlet-pea may occur. Sparse tree and shrub cover may be composed of species such as cedar elm, gum bumelia, sugar hackberry, sweetgum, post oak, eastern redcedar, and loblolly pine.
Pineywoods: Weches Herbaceous Glade	x	This mapped type consists of herbaceous vegetation that may occur over relatively shallow to relatively deeper soils. Grasses such as Bermudagrass, threeawns, hairy grama, Texas grama, little bluestem, and broomsedge bluestem are common components. Shrubs and scattered trees such as eastern redbud, gum bumelia, roughleaf dogwood, eastern redcedar, post oak, and loblolly pine may be present. The shallowest soils may be dominated by species such as poverty dropseed, Texas sedum, and Ozark savory.
Post Oak Savanna: Sandyland Grassland	x	Little bluestem is a common dominant of this type, together with a variety of grasses and forbs common on sands, including curly threeawn, bluntsepal Brazoria, Illinois flatsedge, Florida snakecotton, purple sandgrass, and pinweed. Post oak, blackjack oak, bluejack oak, and sand post oak may be present.
Post Oak Savanna: Savanna Grassland		A variety of grasslands are circumscribed within this type, and disturbance or tame grasses such as Bermuda grass and King Ranch bluestem are common dominants. Little bluestem, Indiangrass, silver bluestem, Texas wintergrass, tall dropseed, and brownseed paspalum are native species that may be important. Broomweed and western ragweed are common weedy herbaceous species. Mesquite is a common shrub, and may be dense enough to qualify as shrubland in some areas.

TEXAS NAME	Prairie	Description
Red River: Floodplain Herbaceous Wetland	x	A variety of herbaceous vegetation on floodplains occurs within this mapped type. Marshes with sedges, rushes, and other wetland species may dominate, and drier areas may support little bluestem, broomsedge bluestem, bushy bluestem, switchgrass, or introduced grasses such as Johnsongrass and Bermudagrass. Shrubs and small trees may include black willow, wax-myrtle, common buttonbush, and sweetgum.
Red River: Floodplain Wet Prairie		Introduced grasses such as Bermudagrass, and Johnsongrass may dominate many areas of this mapped type, and natives such as broomsedge bluestem, bushy bluestem, switchgrass, little bluestem, and Florida paspalum may be important in some areas. Common sparse woody cover may include black willow, wax-myrtle, bois d'arc, cedar elm, and common buttonbush.

Works Cited

Adelman, C., and B. L. Schwartz. 2013. *Prairie Directory of North America: The United States, Canada, and Mexico.* 2nd ed. New York: Oxford University Press.

Anderson, R. C. 2006. Evolution and origin of the central grassland of North America: climate, fire and mammalian grazers. *Journal of the Torrey Botanical Society* 133.4: 626-647.

Axelrod, Daniel I. 1985. Rise of the grassland biome, central North America. *The Botanical Review* 51 no. 2 (April-June): 163-201.

Barone, J. A. 2005a. Historical presence and distribution of prairies in the Black Belt of Mississippi and Alabama. *Castanea* 70 no. 3: 170-183.

Barone, J. A. 2005b. The historical distribution of prairies in the Jackson Prairie Belt and in western Mississippi. *Journal of the Mississippi Academy of Sciences* 50 no. 2: 144-48.

Baskin, J. M., C. C. Baskin, & E. W. Chester. 1999. The Big Barrens Region of Kentucky and Tennessee. In Savannas, barrens, and rock outcrop plant communities of North America, ed. R. C. Anderson, J. S. Fralish. & J. M. Baskin, 190-205. Cambridge: Cambridge University Press.

Campbell, J.J.N. and W.R. Seymour, Jr. 2012. The flora of Pulliam Prairie, Chickasaw County, Mississippi: a significant remnant of native vegetation in the Black Belt region. Journal of the Mississippi Academy of Sciences 57: 160-195.

Chapman, K., M. White, R. Johnson, and Z. M. Wong. 1990. An approach to evaluate long-term survival of the tallgrass prairie ecosystem. Minneapolis, MN: The Nature Conservancy, Midwest Regional Office.

Diamond, D. D. and L.F. Elliott. 2015. Oklahoma ecological systems mapping interpretive booklet: Methods, short type descriptions, and summary results. Oklahoma Department of Wildlife Conservation, Norman.

Dey, Dan C.; Kabrick, John M. 2015. Restoration of midwestern oak woodlands and savannas. In *Restoration of boreal and temperate forests, 2nd edition*, ed. J. A. Stanturf, 401-428. Boca Raton, FL: CRC Press.

Estes, D., M. Brock, M. Homoya, A. Dattilo. 2016. A Guide to Grasslands of the Mid-South. Published by the Natural Resources Conservation Service, Tennessee Valley Authority, Austin Peay State University and the Botanical Institute of Texas.

Fenneman, N. M. 1938. *Physiography of Eastern United States.* New York: McGraw-Hill Book Company, Inc.

Fisher, R. J. and S. K. Davis. 2010. From Wiens to Robel: A review of grassland-bird habitat selection. *Journal of Wildlife Management* 74 (2): 265-273.

Georgia Department of Natural Resources, Wildlife Resources Division. New life for rare Oaky Woods prairies. Press release. Accessed May 2, 2016. http://www.georgiawildlife.com/node/2735.

Harper, L. 1857. Preliminary Report on the Geology and Agriculture of the State of Mississippi. Jackson, MS: E. Barksdale, State Printer.

Hilgard, E. 1860. Report on The Geology And Agriculture of The State of Mississippi. Jackson, MS: E. Barksdale, State Printer.

Illinois Natural Areas Inventory Update: 2007 – 2010 Documenting the biological heritage of Illinois. Brochure. Accessed October 19, 2015. http://wwx.inhs.illinois.edu/files/4713/4021/2077/INAI3foldflyer.pdf.

Illinois Natural Areas Inventory: Documenting the condition of existing category 1 natural areas. Website accessed October 19, 2015. http://wwx.inhs.illinois.edu/research/inai/documentingareas.

Jordan III, W, R. 1997. Forward to *The Tallgrass Restoration Handbook for Prairies, Savannas and Woodlands*, ed. S. Packard and C. F. Mutel. Covelo, California: Island Press: xiii-xviii.

Kawula, R., 2009. Florida land cover classification system. Center for Spatial Analysis, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission. State Wildlife Grant SWG T-13 (FWRI Grant# 6325). Tallahassee, Florida.

Kimmel, Fred. 2008. Louisiana Cajun Prairie: An Endangered Ecosystem. *Louisiana Conservationist,* Summer.

Lockett, S. H. 1969. *Louisiana As It Is: A Geographical and Topographic Description of the State,* ed. L. C. Post. Baton Rouge: Louisiana State University Press.

Ludeke, K., German, D. and Scott, J., 2009. Texas vegetation classification project: interpretive booklet for phase II. Texas Parks and Wildlife Department and Texas Natural Resources Information System, Austin, USA.

Mierzwa, Kenneth S. 1997. Amphibians and reptiles. In Blackland Prairies of the Gulf Coastal Plain: Nature, Culture and Sustainability, ed. Evan Peacock and Timothy Schauwecker, 1-7. Tuscaloosa, Alabama: The University of Alabama Press.

Moran, L. P., D. E. Pettry, R. E Switzer, S. T. McDaniel and R. G. Wieland. 1997. Soils of native prairie remnants in the Jackson Prairie Region of Mississippi. Bulletin 1067. Mississippi Agricultural and Forestry Experiment Station, Mississippi State, MS.

NatureServe. 2015. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://explorer.natureserve.org. (Accessed: August 9, 2016).

Nelson, P.W. 2011. Fire-adapted natural communities of the Ozark highlands at the time of European settlement and now. In Proceedings of the 4th fire in eastern oak forests conference, ed. D.C. Dey, M.C. Stambaugh, S.L. Clark and C.J. Schweitzer, 92-102. USDA Forest Service, Northern Research Station, Gen. Tech. Rep. NRS-P-102.

Nelson, P. W., J. A. Fitzgerald, K. Larson, R. McCoy, A. Schotz, J. Taft, T. Witsell, B. Yahn. 2013. Central Hardwoods Joint Venture Glade Conservation Assessment for the Interior Highlands and Interior Low Plateaus of the Central Hardwoods Region. Central Hardwoods Joint Venture. http://www.chjv.org/projects.html.

Nature Conservancy. 2006. Conservation by design: A strategic framework for mission success. Arlington, VA

Noss, R. F. 2013. Forgotten Grasslands of the South: Natural History and Conservation. Washington, DC. Island Press.

Lowe, E. N. 1915. Mississippi: Its Geology, Geography, Soils and Mineral Resources. Jackson, Mississippi: Tucker Printing House.

Rostlund, E. 1957. The myth of a natural prairie belt in Alabama: an interpretation of historical records. *Annals of the Association of American Geographers* 47: 392-411.

Sims, P. L. and P. G. Risser. 2000. Grasslands. In *North American Terrestrial Vegetation, Second Edition*, ed. M. G. Barbour and W. D. Billings. Cambridge UK: Cambridge University Press: 323-56.

Singhurst, J. 2009. Conserving Fleming prairies and the Missouri Coneflower in the Pineywoods. *Eye on Nature, A publication of the Wildlife Division – Getting Texans Involved.* Texas Parks and Wildlife.

Schotz, A. and Barbour, M., 2009. Ecological assessment and terrestrial vertebrate surveys for Black Belt Prairies in Alabama. Alabama Natural Heritage Program, Environmental Institute, Auburn University, Auburn. Report submitted to Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, State Wildlife Grants Program, Montgomery.

U. S. Environmental Protection Agency. 2013. Level IV Ecoregions of the Conterminous United States. U.S. EPA Office of Research & Development (ORD) - National Health and Environmental Effects Research Laboratory (NHEERL). Corvallis Oregon.

U.S. Geological Survey, Gap Analysis Program (GAP). May 2016. Protected Areas Database of the United States (PAD-US), version 1.4 Combined Feature Class.

Whilhelm, G. 2004. What is savanna? In Proceedings of SRM 2002: Savanna/Woodland Symposium, ed. G. Hartman, S. Holst, and B. Palmer, 3-8. Jefferson City: Missouri Department of Conservation Press.