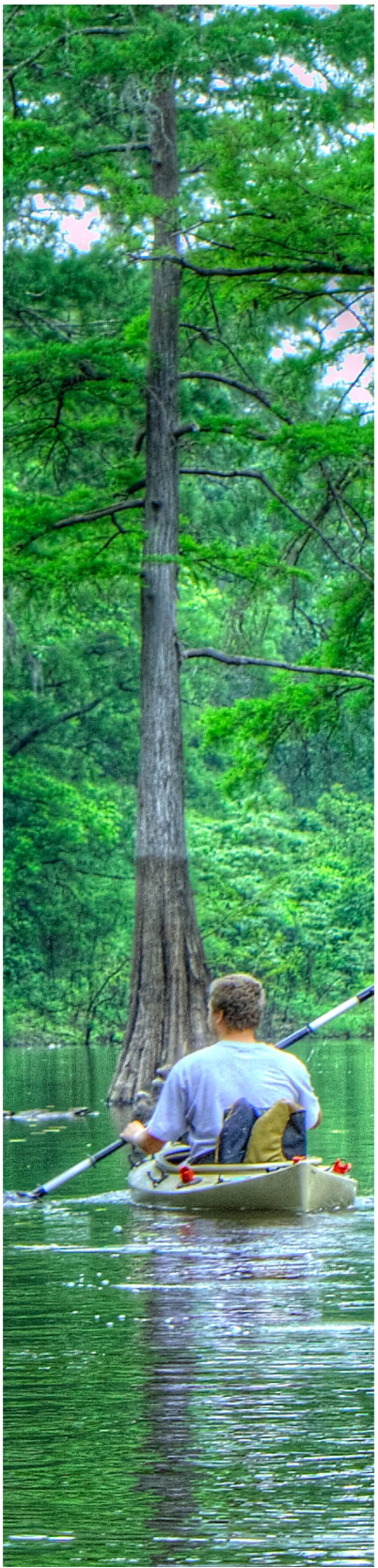
The State of the Gulf Coastal Plains & Ozarks

2017 Report



State of the Gulf Coastal Plains & Ozarks

2017

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State of the Gulf Coastal Plains & Ozarks

2017

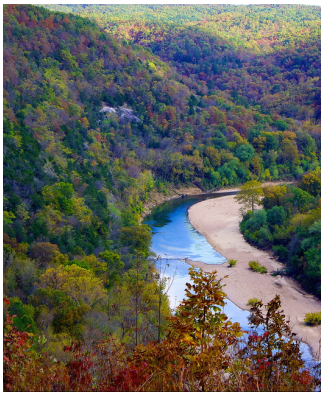
Introduction

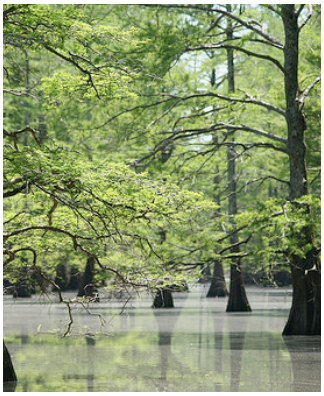
The Gulf Coastal Plains and Ozarks is a 180-million-acre region that includes all of Arkansas and Mississippi and parts of 10 additional states spanning 5 major subgeographies: the Ozark Highlands (OZHI), West Gulf Coastal Plain (WGCP), East Gulf Coastal Plain (EGCP), Mississippi Alluvial Valley (MAV), and Gulf Coast (GC).

From 2014 to 2017, the **Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative** (GCPO LCC) conducted research, assembled experts and spatial datasets, and conducted a series of complex analyses to produce peer-reviewed written drafts of **Ecological Assessments** for eight of our nine priority systems (the Beaches and Dunes Assessment is in progress using recently acquired LiDAR data). This included generating condition index maps for each system, and developing those maps into a comprehensive **Draft Conservation Blueprint 1.0** to guide resource allocation and support management decisions across all nine priority systems. The habitat-specific maps were integrated into a single map ranking watersheds according to conservation priorities across the region. This report presents an overview of the development of the Conservation Blueprint from the Ecological Assessments, and includes a standardized assessment of the initial desired condition targets and data used, as well as some preliminary results regarding management and protection opportunities for each habitat type, measured in acres or miles.

SCIENCE AGENDA: STRATEGIC HABITAT CONSERVATION

The **Integrated Science Agenda** (ISA) of the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative (GCPO LCC) establishes Strategic Habitat Conservation as the framework for accomplishing our mission to define, design, and deliver landscapes capable of sustaining natural and cultural resources now and into the future. The ISA describes 9 broadly defined habitats in terms of desired conditions, or **conservation targets**, for species of greatest conservation need identified in the State Wildlife Action Plans. As of 2017, we have produced detailed ecological assessments of eight of the nine broadly defined habitats identified in the ISA, describing how much of each in what condition exists in our geography.



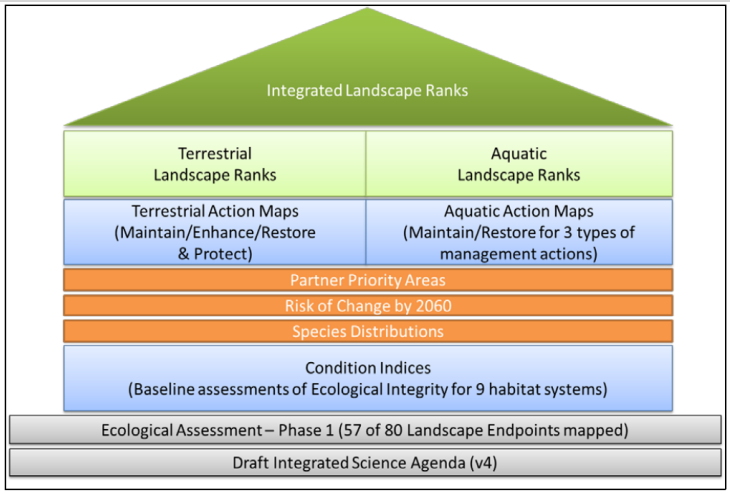


Subgeography portraits: Upland hardwoods and river in the OZHI (Doug Wertmann); Open pine in the E/WGCP (Toby Gray, GCPO LCC); Forested wetlands in the MAV (Jeremy Bennett, USFWS); Tidal marsh along the Gulf Coast (Gretchen Grammer, NOAA)

FROM ECOLOGICAL ASSESSMENTS TO CONSERVATION BLUEPRINT

The ecological assessment data are available for review at the **GCPO LCC Conservation Planning Atlas**. Each assessment includes a Condition Index spatial data map that scores land or water units based on the presence of the desired conditions as indicated by the ecological assessments. Our Conservation Blueprint incorporates additional datasets, (i.e. predictions of urbanization and climate change, species distribution models, depictions of conservation partner interest) to identify and rank conservation actions (maintain, enhance, restore) and to support resource allocation decisions within the GCPO LCC. The Blueprint will be iteratively updated.

Conceptual Model of how spatial data products of the Conservation Blueprint are linked



METHOD OVERVIEW: FROM ECOLOGICAL ASSESSMENTS TO CONDITION INDEX TO CONSERVATION BLUEPRINT

Each Priority System is addressed through a written Draft **Ecological Assessment** and a **Condition Index** that ascribes a numeric evaluation of landscape configuration and condition to each map unit. For terrestrial systems, map units are 250 meter pixels; for aquatic systems, map units are stream segments identified by the National Hydrographic Database (NHD). The written assessments are posted on our website **www.gcpolcc.org**.

The **Condition Index** is generated by first answering questions about the large landscape in which the pixel or segment resides, assigning it to broad score bins based on patch size and configuration metrics, then by enumerating desired site condition characteristics indicated for that pixel or segment.

Project Highlight: Ground Truthing

In 2016, through a project supported by the GCPO LCC, scientists from several LCC partner organizations, including NatureServe, The U.S. Fish and Wildlife Service, and the East Gulf Coastal Plain Joint Venture, developed a set of desired condition metrics for southern open pine ecosystems. Using existing decision support tools, published studies on species habitat relationships, and meetings with stakeholders and experts, this project identified rapid field protocols for measuring desired basal area and percent cover for overstory, midstory and ground layers for 13 "Southern Open Pine Groupings."

That same year, GCPO staff assisted a Mississippi State University undergraduate researcher on testing the protocols for the Upper Coastal Plain Pine Flatwoods Group by collecting bird count and forest condition data in the Sam D. Hamilton Noxubee National Wildlife Refuge. In 2017, this research project was expanded to include upland hardwood forests, another priority system identified by the ISA.

Through projects such as these, the GCPO LCC continues to review the validity of habitat condition targets for each of our priority systems. Our ecological assessment protocol, and the geoprocessing steps that develop the resulting Condition Index data layers into products, such as the Conservation Blueprint and Management Opportunity and Protection Opportunity maps, is methodical, repeatable, transparent, and under continuous review.

Toby Gray

Ecological Assessments: Evaluating the conservation target metrics and the datasets used

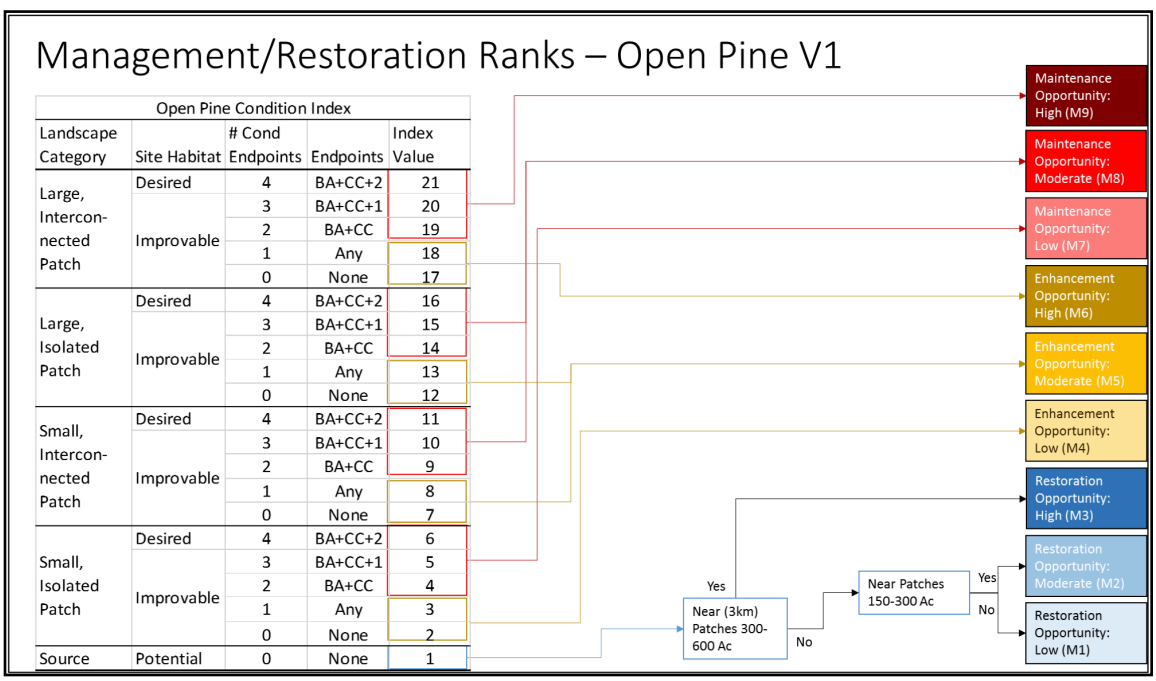
This report contains tables evaluating the landscape condition targets and the geospatial datasets used to generate the Ecological Assessments and the Condition Indices. These scores are presented here to identify opportunities to improve either the conservation target, the available geospatial dataset, or both. This assessment of the conservation targets and the input dataset applies a three-level Likert score to the four elements. Two scores refer to the Conservation Target: **specificity**, or how well-defined the target is (quantitative metrics are preferred), and **utility**, referring to the "mappability" of the target (some very important variables, easily measured at the site level, are difficult to measure across large landscapes). Two scores refer to the dataset used in the analysis: **relevance** addresses whether the dataset measures the same variable in exactly the same manner, and **rigor** addresses whether the dataset is widely accepted by the scientific community. Scores range from 1 – 5 with one being least desirable and five being most desirable.

A cool-to-warm (blue to orange) color fill is used in these assessment tables to reinforce the interpretation of the values. Scores for each Conservation Target (rows) are averaged to provide relative summaries of the usefulness of conservation target datasets to the ecological assessment. Scores are also averaged in columns to provide an overall sense of the quality of data for each system. These tables provide a snapshot of the state of the science for each system. Average scores will help guide science needs within systems (rows) and among systems (columns).

	Target Assessment		Data Assessment	
	Specificity	**Utility**	**Relevance**	**Rigor**
1	Expression of target uses poorly-defined terms (i.e. "shrub") or vague metric (i.e. "low temperature").	No available dataset addresses the target over large areas	No dataset available	No dataset available
3	Target refers to a specific value when a range of values is appropriate (i.e. ~40 trees/acre, we re-defined as 30-50 trees/acre)	Dataset specifically addressing this target not available, but proxy datasets are	Proxy data (i.e. midstory tree density to address percent midstory hardwood cover, tons carbon per acre to address coarse woody debris)	Unpublished data shared with us by partners (i.e. USFS MODIS FIA imputed forest condition)
5	Target expression uses widely understood terms and a range of target values (i.e. overstory canopy 60-70%)	Target expressed in variables commonly measured across large landscapes (i. e. canopy cover)	Dataset addresses same variable as target, measured in the same way	Published, widely available dataset (i.e. NLCD 2011)

Conservation Blueprint Products: Management and Protection Opportunities

Because the **Condition Index** process addresses large landscape elements such as patch size, configuration and proximity before addressing smaller scale condition targets related to forest structure and vegetation characteristics, lower quality map units in large contiguous patches rank higher than high quality units in smaller,

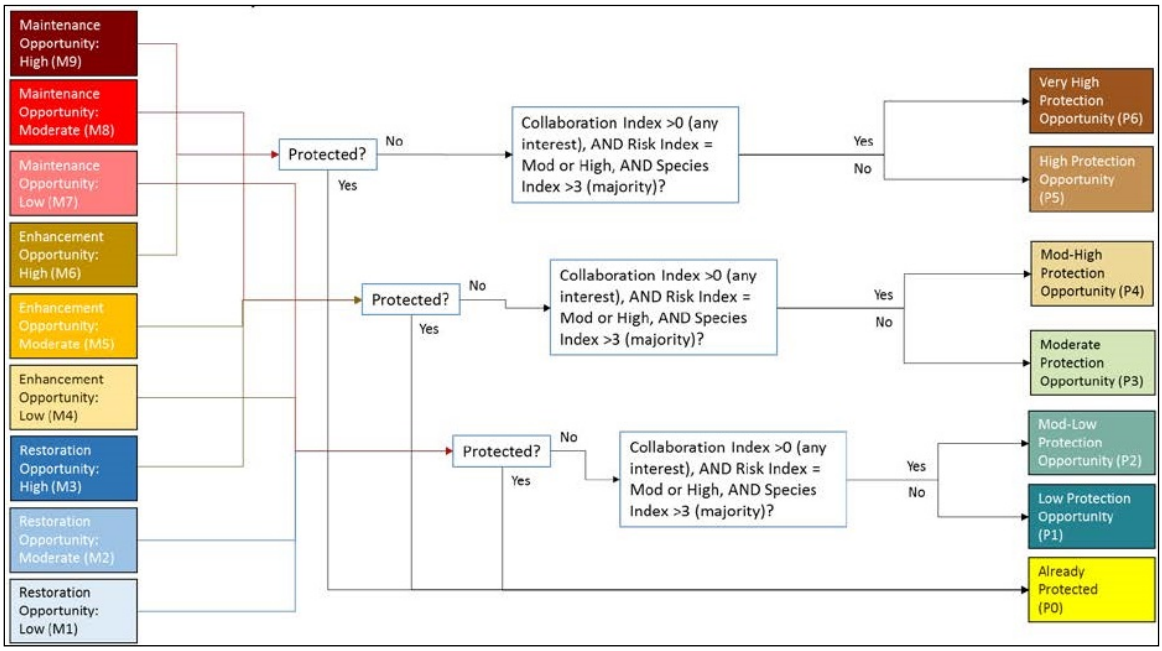


fragmented patches. The **Management Opportunity maps** organize the CI scores by the pattern of large landscape configuration and site-level condition scores to better inform resource allocation and management decisions across the region. We define a **Restore** category when land is appropriate for habitat but currently in another use, such as agriculture; **Enhance** means habitat exists currently, but out of conditions; and **Maintain** means more than one condition target is present across all patch size and configuration categories.

The **Protection Opportunity maps** organize the CI information for terrestrial systems even further by considering protected areas, threats from urbanization and climate change, partner interest, and indications of greater potential for the presence of species of greatest conservation need (SGCNs) as defined in state wildlife action plans.

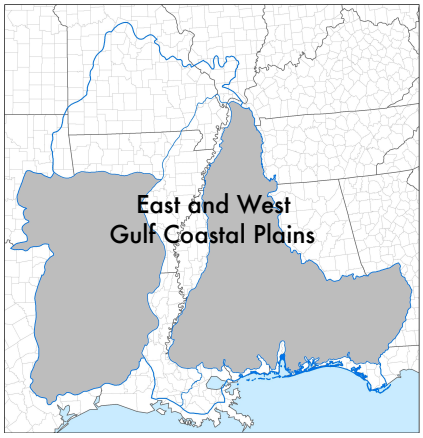
Protection was not assessed for aquatic systems because partners did not believe that presence of protected lands around a stream necessarily equated to conservation or management of the stream. Management Opportunities for streams and rivers was assessed separately for the riparian zone and the contributing watershed. These ranks included threats from urbanization and climate change, partner interest, and indications of greater potential for the presence of species of greatest conservation need (SGCNs) as defined in state wildlife action plans.

This document includes stacked bar graphs describing acres of land or kilometers of stream classified as restore, enhance, maintain, and describing protection levels for the relevant systems, based on data from Management and Protection Opportunity maps. A full explanation plus the maps themselves can be found on the **Conservation Planning Atlas Blueprint Gallery.**



P6 - Very High	A variety of structure and vegetation conditions in large interconnected patches, some indication of partner collaboration, high threat of change, high probability of SGCN presence
P5 - High	A variety of structure and vegetation conditions in large interconnected patches, no partner collaboration, low threat of change, low probability of SGCN presence
P4 - Moderate High	Highly degraded conditions in larger, less fragmented patches, including potential habitat in other land uses in proximity to large patches, OR high quality conditions in EITHER large OR contiguous pathces, some indication of partner collaboration, high threat of change, high probability of SGCN presence
P3 - Moderate	Highly degraded conditions in larger, less fragmented patches, including potential habitat in other land uses in proximity to large patches, OR high quality conditions in EITHER large OR contiguous pathces, no partner collaboration, low threat of change, low probability of SGCN presence
P2 - Moderate Low	Highly degraded conditions in smaller, fragmented patches, including potential habitat in other land uses, some indication of partner collaboration, high threat of change, high probability of SGCN presence
P1 - Low	Highly degraded conditions in smaller, fragmented patches, including potential habitat in other land uses, no partner collaboration, low threat of change, low probability of SGCN presence
P0 = Already Protected	Already Protected

The Gulf Coastal Plains & Ozarks Region



From within the Gulf Coastal Plains and Ozarks region, we have initially selected 9 priority habitat systems for assessment. With the exception of two that occur only on the Gulf Coast, these habitats are found in varying degrees throughout the region. However, they are shown here in association with the **subgeography** where they predominate.

Upland Streams

Upland Hardwoods

Medium-gradient Streams

Open Pine

Grassland-Prairie-Savanna

Mainstem Big Rivers

Forested Wetlands

Tidal Marsh

Beaches & Dunes

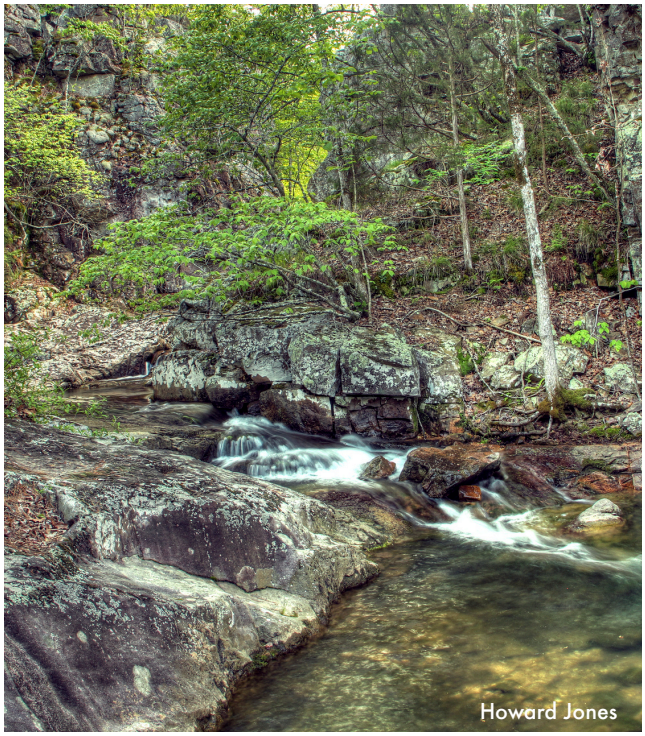
The **Ozark Highlands (OZHI)** holds 66% of **Upland Streams** and 39% and 68% of **Upland Hardwood Forest** and **Upland Hardwood Woodlands**, respectively, within the GCPO. Opportunities exist to improve stream connectivity and riparian conditions in some watersheds. Much of the region is heavily forested, making enhancement of forest conditions a high priority, especially for fire-adapted woodland communities.

The **East and West Gulf Coastal Plains (EGCP & WGCP)** are similar and together contain 75% of **Medium-gradient Stream** miles as well as 94% of **Open Pine** and 65% of **Grassland-Prairie-Savanna** in the region. This region includes areas of very high aquatic biodiversity, making stream maintenance and restoration a high priority. Opportunities exist to enhance pine forests, working with conservation partnerships and private industrial forests. Grasslands are greatly reduced from historical levels making protection and maintenance, as well as restoration to expand the coverage of existing tracts, a high priority.

Within the **Mississippi Alluvial Valley (MAV),** 31% of **Mainstem "Big Rivers,"** including the lower Mississippi River itself, and 36% of **Forested Wetlands**, also known as bottomland hardwoods, occur. Mainstem rivers have been significantly disconnected from their floodplains by flood control levees. Approximately 90% of this area's forested wetlands have been converted to agriculture, making restoration of both forests and floodplains a priority, as well as restoration of lateral connectivity to the floodplain.

Beaches and Dune systems and **Tidal Marsh** are restricted to the **Gulf Coast (GC)** subgeography. Much synergy currently surrounds work aimed at ensuring "migration corridors" for tidal marsh, which can move upland in response to sea level rise when the space is available. In addition, conservation leaders are researching and engaging communities concerning "green infrastructure" development and open space protection as a means of achieving increased coastal community resilience.

Upland Streams and Rivers



Desired Condition: *Small springs, runs, and headwaters characterized by clear, clean, and relatively cold water in largely undisturbed forest settings.*

The distribution of upland streams and rivers predominantly lies in the Ozark Highlands subgeography and the Ouachita Mountains portion of the West Gulf Coastal Plains, with a small portion in the East Gulf Coastal Plain. This stream type is essentially absent from the other two subgeographies.

Ecological Assessment

Our assessment defined upland streams and rivers as free flowing streams having an average annual flow between 10 and 6,000 cubic feet/second (cfs) and sitting at an elevation >130 meters according to the National Hydrography Dataset (v2). The elevation threshold is based on fish distribution data from the **GCPO SARP project**.

Our analysis produced a Condition Index from the input data sets that showed a majority of this class of stream in the GCPO are impacted by land use, with most of the higher ranking streams occurring in the highly dissected areas of the Ouachita, Boston, and Ozark Mountains. Spatial datasets used with confidence include the NLCD. The GCPO has funded the Southeast Aquatic Resources Partnership to provide better data on barriers (linear connectivity) and the USGS to provide better data on flow characteristics.

Overall Appraisal of Conservation Targets and Datasets Used to Assess Them
(see page 3 for information about this table)

Value Interpretation	Needs Improvement → Good				
	1	2	3	4	5
Conservation Target (from Integrated Science Agenda)	**Target Assessment**		**Data Assessment**		**Average**
	Specificity	**Utility**	**Relevance**	**Rigor**	
Maintain current river miles	5	5	5	5	5
Watershed >75% forested, with <10% impervious cover	5	5	5	1	4
Intact riparian corridors consisting primarily of hardwoods within 30 m buffer of stream	3	3	1	1	2
Interconnected stream systems	1	3	3	3	2.5
High water quality, with minimal contaminants and nutrients	1	3	3	3	2.5
Temperature: low	1	3	3	3	2.5
Dissolved oxygen - high	1	1	1	1	1
Sediment: minimal	1	3	1	3	2
Groundwater flow regime: low flow variability, low peak flows, low frequency of low flows	1	1	1	1	1
Runoff flow regime: moderate flow varaiability, moderate peak flows, moderate frequency of low flows	1	1	1	1	1
Intermittent flow regime: high flow varaibility, high peak flows, high frequency of low flows	1	1	1	1	1
Abundant leaf litter	1	1	1	1	1
Variety of substrates, gravel to boulders	1	1	1	1	1
Average	1.8	2.4	2.1	1.9	2.0

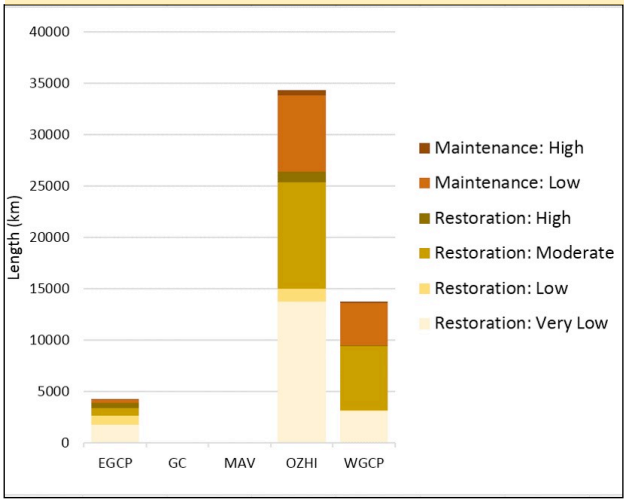
Conservation Blueprint

Management Opportunities data describe recommended management actions derived from the condition index at 2 spatial scales: Watershed and Riparian. At the Watershed scale, **Maintain** indicates the contributing watershed meets the desired targets for forest and impervious cover, whereas **Restore** indicates these targets are not met (see page 3). Good condition streams are concentrated areas dominated by steep topography.

At the Riparian scale, **Maintain** indicates a majority (>75%) of the 100-m riparian buffer is forested, whereas **Restore** indicates this target is not met (see page 4). Good condition streams are somewhat more evenly distributed across the region.

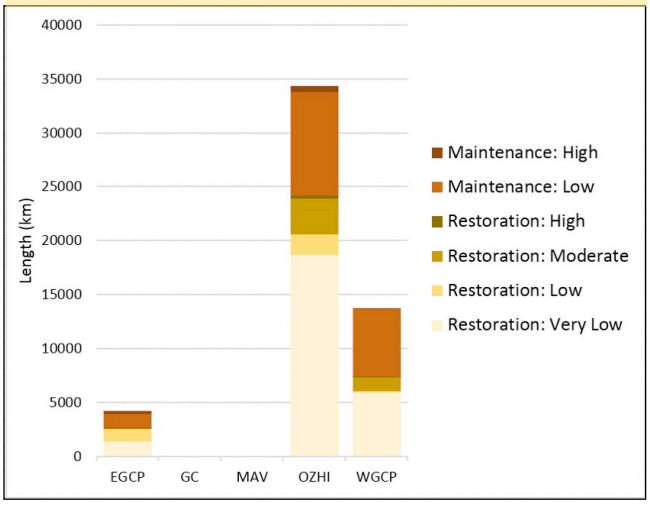
Upland Streams & Rivers

How much of the stream's contributing watershed is largely forested?



Upland Streams & Rivers

How much of the stream's riparian zone is majority forested?



WATERSHED STATUS

Acreage available to:

RESTORE: 24,702 river miles (76%)

MAINTAIN: 7,788 river miles (24%)

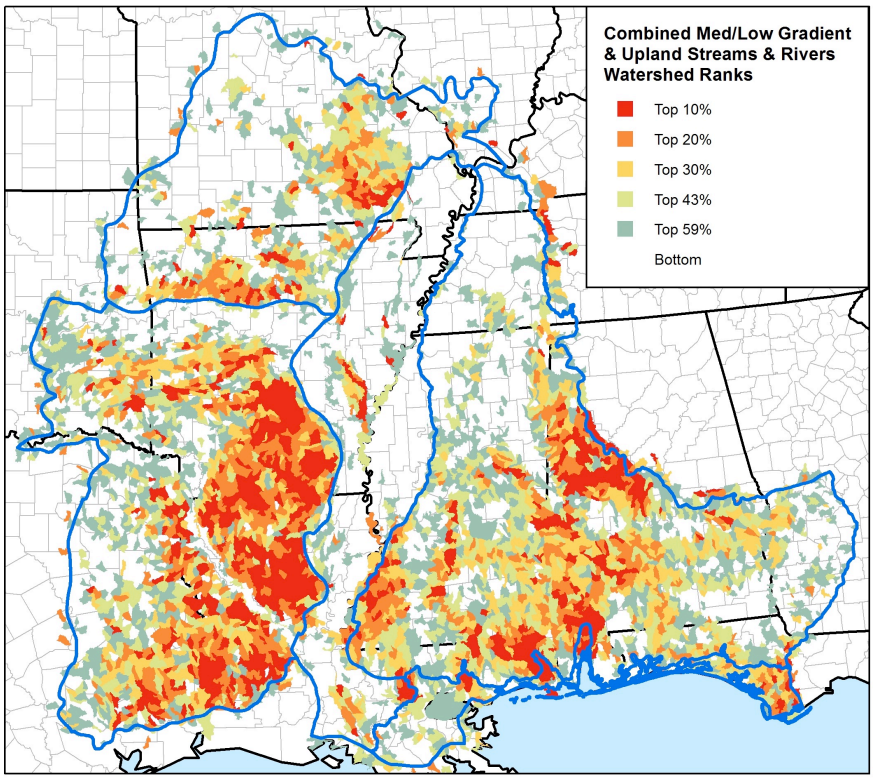
RIPARIAN STATUS

RESTORE: 21,264 river miles (65%)

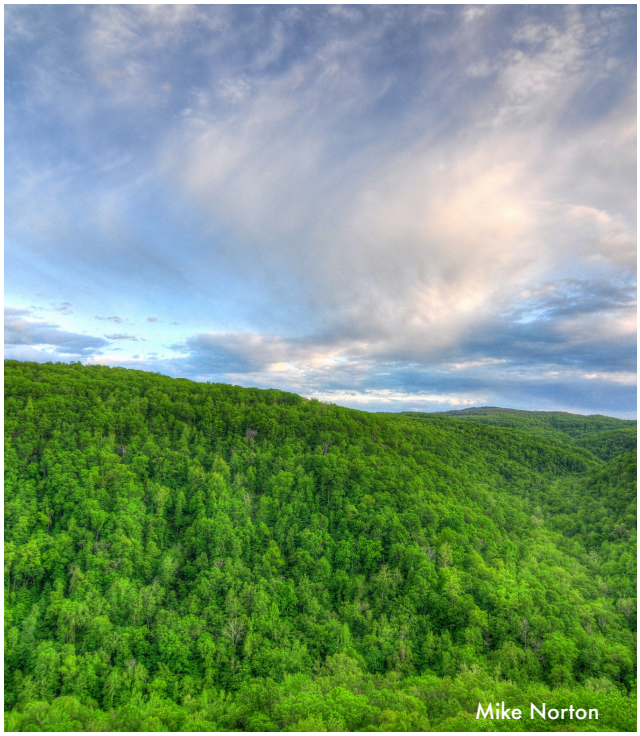
MAINTAIN: 11,226 river miles (35%)

Our **Upland and Medium/Low-gradient Streams & Rivers Watershed Ranks** blueprint map estimates the relative condition of watersheds across the GCPO region based on the length of river segments rated Maintain or Restore.

Where are our best opportunities for achieving desired conditions?



Upland Hardwoods



Desired Condition: *Large blocks of oak forest and woodland in appropriately distributed successional stages in predominantly forested landscapes. Woodlands characterized by moderate canopy cover and tree densities that allow ample light to reach the ground, supporting a variety of grasses and forbs. Forests characterized by nearly closed overstory canopy with well-developed subcanopy, shrub, and understory strata of shade-tolerant species.*

The Ozark Highlands have historically been dominated by a matrix of oak-hickory upland hardwood and mixed pine-hardwood systems, with upland hardwoods found in both open woodland and closed-canopy conditions. Large tracts of public and private forest land render the upland hardwood system in this geography unique and critical to many wildlife species, particularly those requiring large forest patches.

Ecological Assessment

Our analysis found 30.5 million acres of upland hardwood forest and 2 million acres of upland hardwood woodland in the region, using geospatial data from NLCD, GAP, LANDFIRE, and USFS Remote Sensing Applications Center.

Overall Appraisal of Conservation Targets and Datasets Used to Assess Them
(see page 3 for information about this table)

Value Interpretation	Needs Improvement → Good				
	1	2	3	4	5

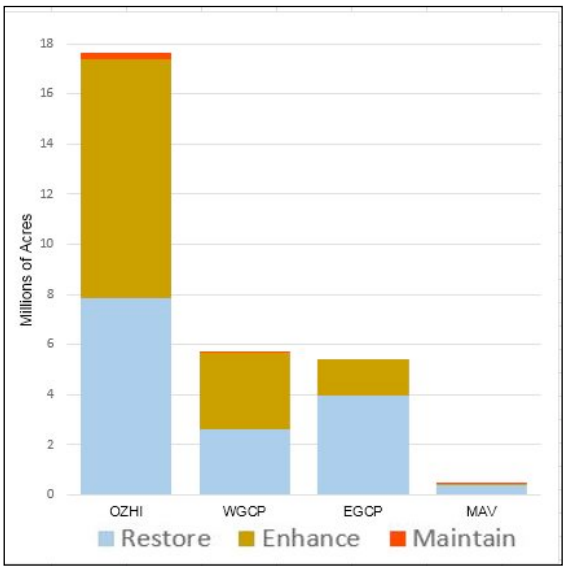
Conservation Target (from Integrated Science Agenda)	Target Assessment		Data Assessment		Average
	Specificity	Utility	Relevance	Rigor	
2.6 Million Acres (1.9 million acres woodland; 0.7 million acres forest)	5	5	3	5	4.5
Forest patch size >=5000 acres of interdigitated forest habitat types	5	5	5	5	5
Landscape composition (woodland and forest in 10-km radius): >70%	5	5	5	5	5
Adequate connectivity	1	3	1	1	1.5
Structure: Overstory Canopy Cover: Woodland 20-80%; Forest >80%	5	5	5	5	5
Structure: Average DBH >= 14"	5	3	3	3	3.5
Structure: Tree Density: ~40 trees/acre for woodlands, ~80 trees/acre for forests	3	3	5	3	3.5
Structure: Large Snag Density: One large Snag >=16" dbh per 5 acres	3	3	5	3	3.5
Structure: Carbon (downed woody debris): 1 6' log (>= 8" DBH)/acre	5	1	3	3	3
Composition: Oak & Hickory Basal Area: >90% for woodlands, >70% for forests	3	3	5	5	4
Total live tree basal area: 30-80 sq ft/acre for woodlands, 80-100 sq ft/acre for forest	5	3	5	5	4.5
An appropriate distribution of successional stages; <= 10% of the landscape	1	3	3	3	2.5
Fire Return Interval 3 years for woodland, 10 years for forest	3	3	3	3	3
Potential upland hardwood woodlands and forest	5	3	5	5	4.5
Average	3.9	3.4	4.0	3.9	3.8

Conservation Blueprint

The **Management Opportunities** data product describes recommended management actions: **Restore** means appropriate for habitat but currently in another use; **Enhance** means habitat exists out of conditions; and **Maintain** means >1 condition target present across all patch size/configuration classes (see p. 3). Upland Hardwood Woodland is more restricted to the Ozark Highlands (OZHI) and the northern parts of the Coastal Plain (Ouachita Mountains in the West, Fall Line Hills in the East) than are Upland Hardwood Forests.

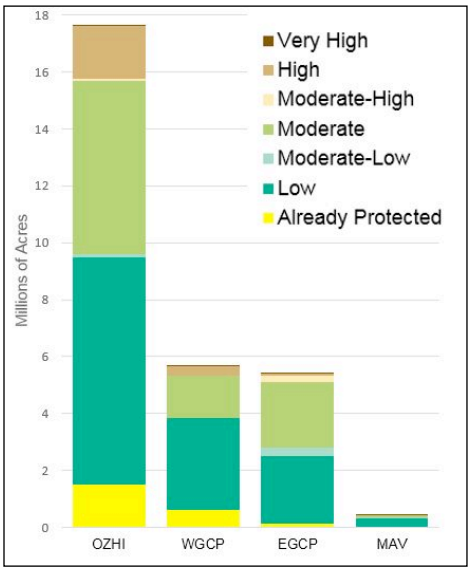
Upland Hardwood Woodland Management Opportunities

How much of the landscape meets targets for desired conditions?



Upland Hardwood Woodland Protection Opportunities

How much of the landscape is protected or high opportunity for protection?



Protection Opportunities

The **Protection Opportunities** data product combines existing protected areas, condition data, threats, partner interest, and likely presence of species of concern to support resource allocation decisions (see p. 4). Large areas of federal land, particularly the Ouachita and Ozark-St. Francis National Forests, play an important role in the regional conservation of this system.

UPLAND WOODLAND CONDITION STATUS

Acreage available to:

RESTORE: 14.8 million

ENHANCE: 14 million

MAINTAIN: 0.3 million

PROTECTION STATUS

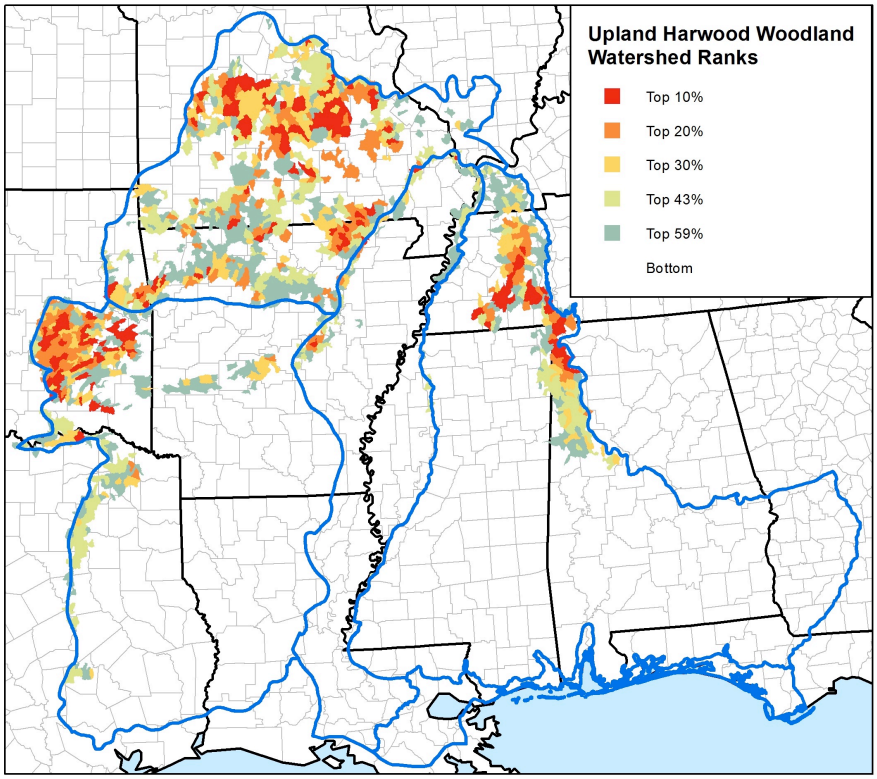
2.3 million acres of upland hardwood woodland already protected

2.23 million acres ranked as high opportunity for protection

0.05 million acres ranked as very high opportunity for protection

Our **Upland Hardwood Woodland Watershed Ranks** blueprint map estimates the relative condition of watersheds within sub-geographies based on the amount of existing upland hardwood woodland and the proportion in desired condition.

Where are our best opportunities for achieving desired conditions?

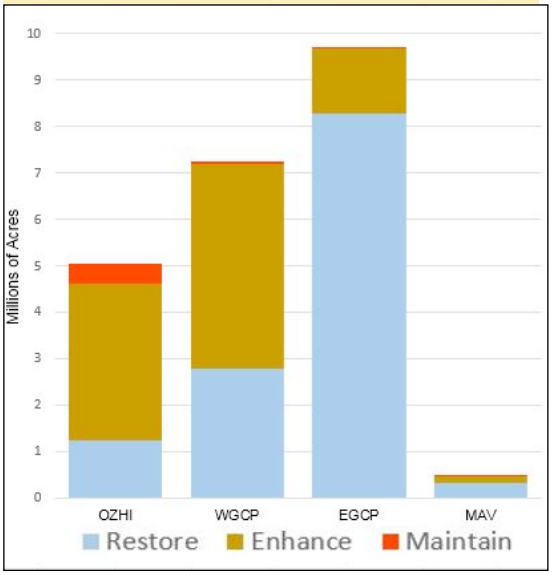


Conservation Blueprint

The **Management Opportunities** data product describes recommended management actions: **Restore** means appropriate for habitat but currently in another use; **Enhance** means habitat exists out of conditions; and **Maintain** means >1 condition target present across all patch size/configuration classes (see p. 3). Upland Hardwood Forest is found across large areas of the OZHI as well as the East and West Gulf Coastal Plains subgeographies.

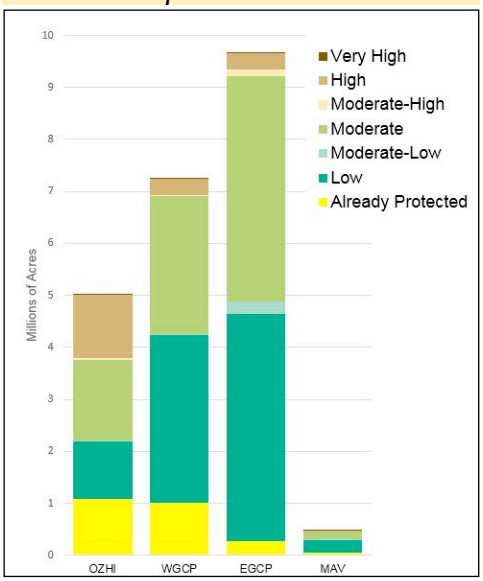
Upland Hardwood Forest Management Opportunities

How much of the landscape meets targets for desired conditions?



Upland Hardwood Forest Protection Opportunities

How much of the landscape is protected or high opportunity for protection?



Protection Opportunities

The **Protection Opportunities** data product combines existing protected areas, condition data, threats, partner interest, and likely presence of species of concern to support resource allocation decisions (see p. 4). Large areas of federal land, particularly the Ouachita and Ozark-St. Francis National Forests, play an important role in the regional conservation of this system.

UPLAND FOREST CONDITION STATUS

Acreage available to:

RESTORE: 12.6 million acres

ENHANCE: 9.3 million acres

MAINTAIN: 0.5 million acres

PROTECTION STATUS

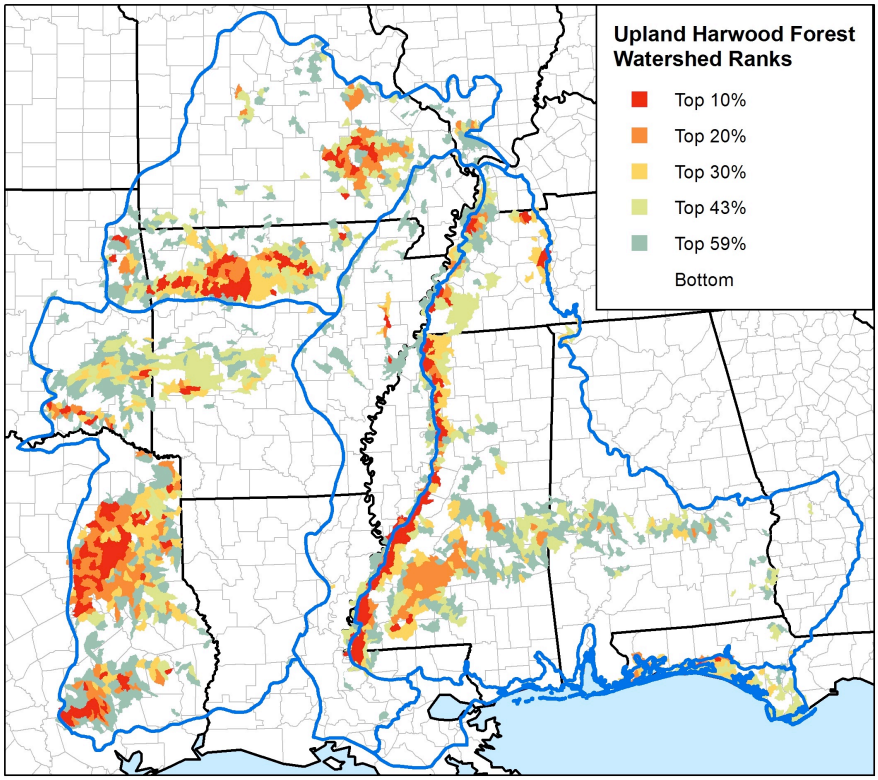
2.4 million acres of pine forest already protected

1.9 million acres ranked as high opportunity for protection

0.04 million acres ranked as very high opportunity for protection

Our **Upland Hardwood Forest Watershed Ranks** blueprint map estimates the relative condition of watersheds within sub-geographies based on the amount of existing upland hardwood forest and the proportion in desired condition.

Where are our best opportunities for achieving desired conditions?



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Medium-low Gradient Streams and Rivers

Robert Nunnally

Desired Condition: *Medium-sized streams and rivers characterized by intact channel morphologies that support riffles and pools and a complex of physical structure (woody debris, leaf litter, and substrate types). Flows are relatively steady, with infrequent periods of low water quantity and high water temperatures.*

This designation includes a large proportion of rivers and streams throughout the GCPO but excludes the smaller and steeper streams that are most abundant across the Ozark Highlands, Ouachita Mountains (WGCP), and higher elevations of the East Gulf Coastal Plains.

Ecological Assessment

Our assessment defined medium-sized streams and rivers as free-flowing streams with an average annual flow of 10 to 6,000 cubic feet/sec (cfs) and sitting at an elevation <=130 meters according to the National Hydrography Dataset (v2). The elevation threshold is based on fish distribution data from the **GCPO SARP project**. Our Condition Index showed a majority of medium-low gradient streams in the region are impacted by land use, with most of the higher ranking streams in the pine belt. Most targets cannot be reliably assessed with existing data because appropriate spatial datasets are severely limited. The GCPO has funded the Southeast Aquatic Resources Partnership to provide better data on barriers (linear connectivity) and the USGS to provide better data on flow characteristics.

Overall Appraisal of Conservation Targets and Datasets Used to Assess Them
(see page 3 for information about this table)

Value Interpretation	Needs Improvement → Good				
	1	2	3	4	5

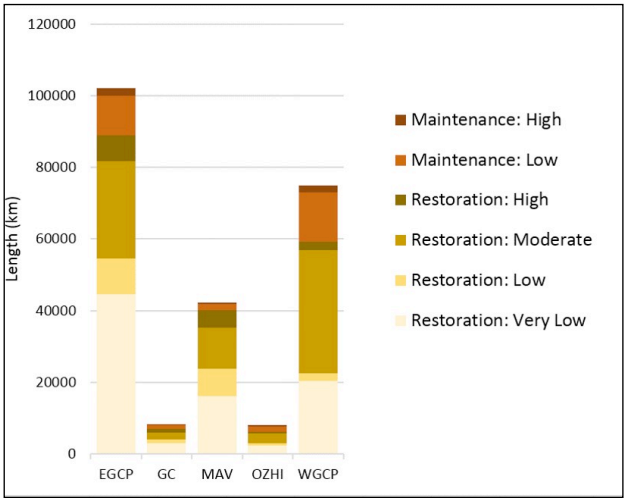
Conservation Target (from Integrated Science Agenda)	Target Assessment		Data Assessment		Average
	Specificity	Utility	Relevance	Rigor	
Maintain current river miles	5	5	5	5	5.0
Connectedness that ensures accessibility of habitats and resources within a watershed	1	1	1	1	1.0
Lateral connectedness: functional connectivity to floodplain habitats	1	5	5	5	4.0
Linear connectedness: functional connectivity of a stream network	1	3	1	1	1.5
Water quality: temperature below critical threshold	1	1	1	1	1.0
Water quantity: Adequate magnitude with limited frequency of low flows conditions	1	3	3	3	2.5
Structure: Intact channel morphologies: natural riffle-pool sequences	1	1	1	1	1.0
Structure: Intact channel morphologies: Meandering channels with natural sinuosity	1	5	5	5	4.0
Structure: High physical structure complexity: High amounts of small woody debris	1	3	3	3	2.5
Structure: High physical structure complexity: Adequate amounts of large woody debris	1	1	1	1	1.0
Structure: High physical structure complexity: Diversity of substrates, including numerous gravel beds and	1	1	1	1	1.0
Average	1.4	2.6	2.5	2.5	2.2

Conservation Blueprint

The **Management Opportunities** data product describes recommended management actions derived from the condition index at two spatial scales: Watershed and Riparian. At the Watershed scale, **Maintain** indicates a majority (>75%) of the contributing watershed is forested, whereas **Restore** indicates this target is not met (see page 3). Headwaters tended to score higher than watersheds farther downstream. At the Riparian scale, **Maintain** indicates a majority of the 100-m riparian buffer is forested, whereas **Restore** indicates this target is not met (see page 3). Good condition streams are more evenly distributed across the region.

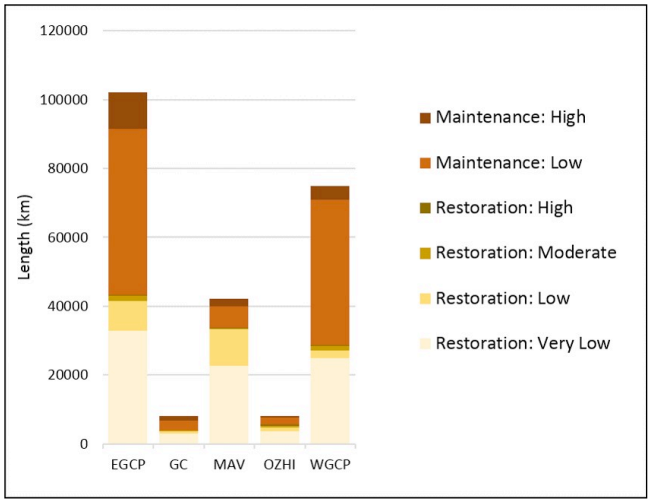
Medium-low Gradient Streams & Rivers

How much of the stream's contributing watershed is largely forested?



Medium-low Gradient Streams & Rivers

How much of the stream's riparian zone is majority forested?



WATERSHED STATUS

Acreage available to:

RESTORE: 125,206 river miles (86%)

MAINTAIN: 21,143 river miles (14%)

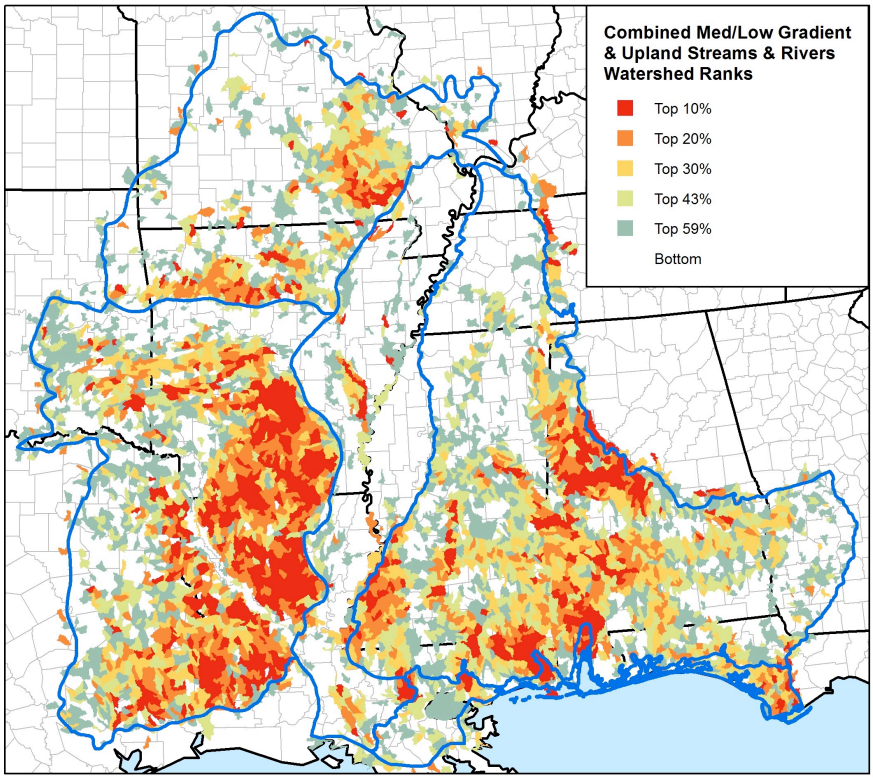
RIPARIAN STATUS

RESTORE: 71,590 river miles (49%)

MAINTAIN: 74,759 river miles (51%)

Our **Medium/Low-gradient and Upland Streams & Rivers Watershed Ranks** blueprint map estimates the relative condition of watersheds across the GCPO region based on the length of river segments rated Maintain or Restore.

Where are our best opportunities for achieving desired conditions?



Open Pine Woodland & Savanna

Toby Gray

Desired Condition: *Open pine woodlands and savannas that are floristically rich and comprised mostly of site-appropriate pine with low basal area, open canopies, and dense herbaceous understories in large interconnected blocks.*

Pine and mixed pine-hardwood forests are abundant in the East and West Gulf Coastal Plain and present in smaller amounts in other GCPO subgeographies. Historically these forests featured open over story canopies, an herbaceous ground layer, and frequent wildfires. Changes in land use/management have reduced both these habitat features and the species that depend on them. Our assessment indicates that only a very small amount is currently in the desired ecological condition.

Ecological Assessment

Our analysis based on available geospatial data indicates the presence of about 47.8 million acres of pine and mixed pine-hardwood forests in a variety of conditions in the GCPO, with an additional 23.5 million acres of potential habitat. A total of 22.4 million acres meet the patch size and configuration threshold targets with at least one condition target met. Patches of sufficient size and connectivity with all condition targets met account for only about 100,000 acres. Spatial datasets used with high confidence include the National GAP Land Cover, USFS Live Tree Species Basal Area, and NLCD 2011 USFS Tree Canopy data.

Overall Appraisal of Conservation Targets and Datasets Used to Assess Them
(see page 3 for information about this table)

Value Interpretation	Needs Improvement → Good				
	1	2	3	4	5

Conservation Target (from Integrated Science Agenda)	Target Assessment		Data Assessment		Average
	Specificity	Utility	Relevance	Rigor	
20 million acres	5	3	3	5	4.0
Patch size >600 acres	5	5	3	5	4.5
<3 km to nearest patch	5	5	3	5	4.5
Basal area (pine) 40-70 ft^2/acre*	5	3	5	3	4.0
DBH >20 ft^2/acre of trees >14" DBH	5	3	3	3	3.5
Canopy cover <50%*	5	5	5	5	5.0
Midstory shrub cover <30%	3	3	3	3	3.0
Midstory hardwoods cover <20%	3	3	3	3	3.0
Herbaceous understory cover >65%	5	1	1	1	2.0
An appropriate distribution of successional stages	3	3	1	1	2.0
Is it Pine Forest? (Pine Mask)	3	3	3	5	3.5
Potential Pine Forest (LANDFIRE BpS)	3	3	5	5	4.0
Average	4.2	3.3	3.2	3.7	3.6

Pine Warbler by Frank Miles, USFWS

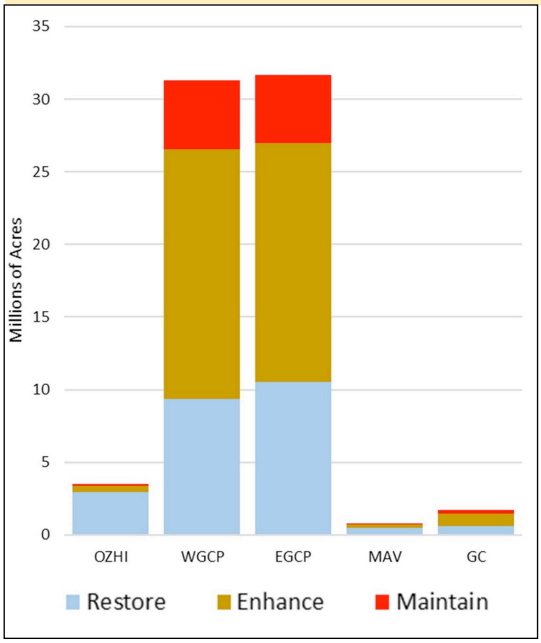
Eastern Indigo Snake, USDA

Conservation Blueprint

Management Opportunities data describe recommended management actions: **Restore** means appropriate for habitat but currently in another use; **Enhance** means habitat exists out of conditions; and **Maintain** means >1 condition target present across all patch size/configuration classes (see p. 3). This analysis indicates widespread capacity for enhancement through thinning and burning, particularly in the East and West Gulf Coastal Plains.

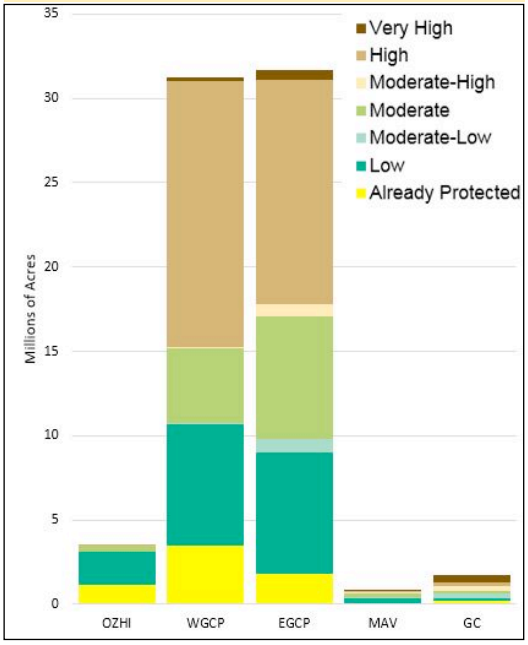
Open Pine Management Opportunities

How much of the landscape meets targets for desired conditions?



Open Pine Protection Opportunities

How much of the landscape is protected or high opportunity for protection?



Protection Opportunities

Protection Opportunities data combine existing protected areas, condition data, threats, partner interest, and likely presence of species of concern to support resource allocation decisions (see p. 4).

Opportunities are most common in the East and West Gulf Coastal Plains, but occur in all 5 subgeographies.

CONDITION STATUS

Acreage available to:

RESTORE: 23.9 million

ENHANCE: 35.1 million

MAINTAIN: 10 million acres

PROTECTION STATUS

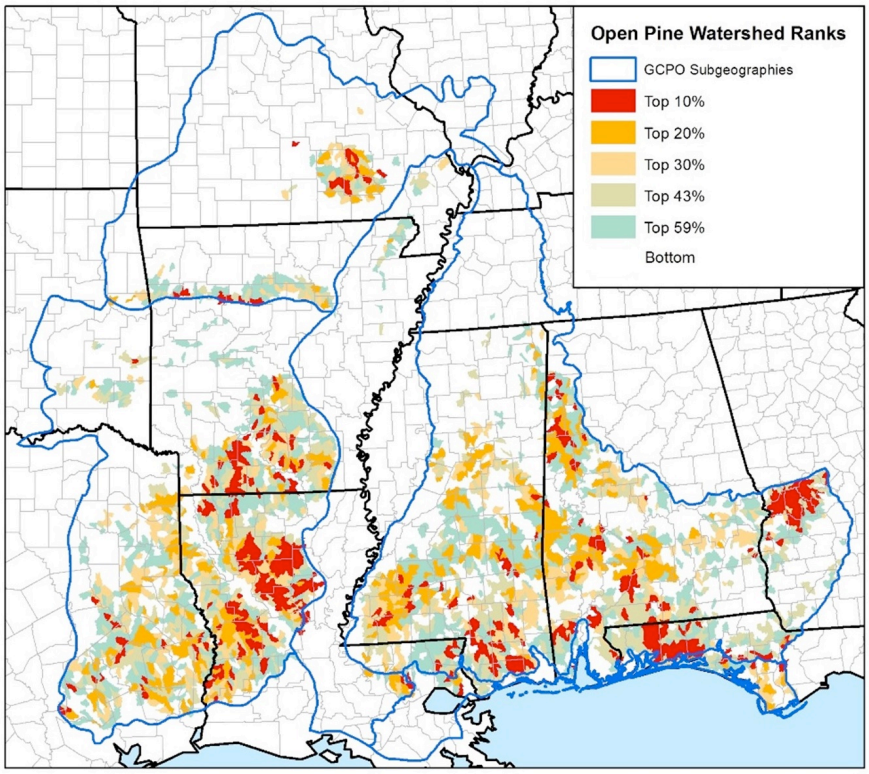
6.7 million acres of pine forest already protected

29.3 million acres ranked as high opportunity for protection

1.3 million acres ranked as very high opportunity for protection

Our **Open Pine Watershed Ranks** blueprint map estimates the relative condition of watersheds within sub-geographies based on the amount of existing pine and the proportion of pine in desired condition.

Where are our best opportunities for achieving desired conditions?



Grassland-Prairie-Savanna

Arkansas Natural Heritage Commission

Desired Condition: *Relatively large patches of dense, tall, and diverse native warm season grasses and forbs.*

Although forest is the dominant natural land cover type in the East and West Gulf Coastal Plain, some areas with calcareous or thin soils, combined with thousands of years of anthropogenic and lightning-struck fires, historically feature scattered patches, many quite large, of open savanna and grasslands. These patches are rapidly disappearing, and many SGCNs depend upon them.

Ecological Assessment

We assessed two categories of grasslands: (1) broadly defined areas dominated by grasses and forbs in a variety of conditions, including pasture and harvested forest regeneration, and (2) prairie, a more restrictive subset dominated by native warm season grasses and forbs. Distinguishing the two is extremely difficult in large landscapes, a science application problem well-known to the landscape conservation community in the Southeast. Our analysis used LANDFIRE's Existing Vegetative Type data layer for the comprehensive grassland map and overlaid it with more accurate state-level records. We identified 32 million acres of broadly defined grasslands, including 4.5 million acres in patches greater than 10,000 acres. For landscapes meeting the more restrictive definition of prairie we found just over 1 million acres. None of those areas identified as prairie met all four of the condition targets assessed, and only 98 acres show the presence of three condition targets. We also identified 11.3 million acres of potential grassland: landscapes identified as grasslands in LANDFIRE BioPhysical Settings but which presently feature other ecological systems.

Overall Appraisal of Conservation Targets and Datasets Used to Assess Them
(see page 3 for information about this table)

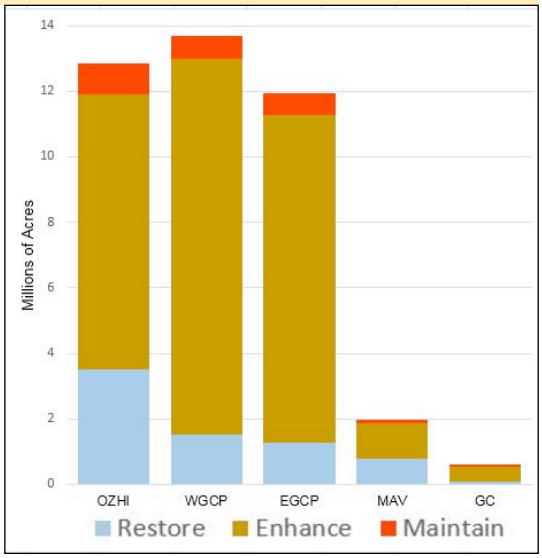
Value Interpretation	Needs Improvement → Good				
	1	2	3	4	5
Conservation Target (from Integrated Science Agenda)	**Target Assessment**		**Data Assessment**		
	Specificity	**Utility**	**Relevance**	**Rigor**	**Average**
100,000 Acres	5	3	3	3	3.5
5 Patches >10,000 acres	5	3	3	3	3.5
500 Patches >100 acres	5	3	3	3	3.5
Vegetation height (grass) 4-6'	5	1	3	3	3.0
Vegetation density very high, nearing 100%.	1	1	1	1	1.0
Bare ground >5% <20%	5	1	3	3	3.0
Shrub cover <20%	5	3	3	3	3.5
Tree density <10/acre	5	3	5	3	4.0
5-year return on disturbance, with 20% of grasses disturbed annually	5	3	3	3	3.5
Is it grass? Grassland Mask*	3	3	3	3	3.0
Is it prairie? Prairie Mask*	3	3	1	1	2.0
Potential Grassland	3	3	5	3	3.5
Average	4.2	2.5	3.0	2.7	3.1

Conservation Blueprint

Management Opportunities data describe recommended management actions: **Restore** means appropriate for habitat but currently in another use; **Enhance** means habitat exists out of conditions; and **Maintain** means >1 condition target present across all patch size/configuration classes (see p. 3). The **Grassland Management Opportunities** data identifies about 2.5 million acres as maintain, exceeding natural prairie acreage because other grassland types are also included.

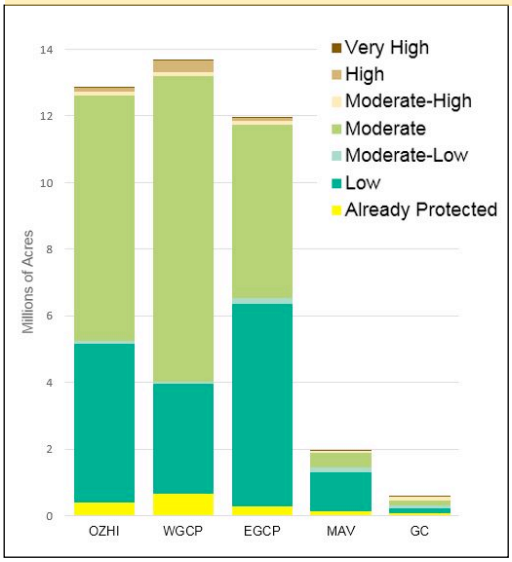
Grassland Management Opportunities

How much of the landscape meets targets for desired conditions?



Grassland Protection Opportunities

How much of the landscape is already protected or high opportunity for protection?



Protection Opportunities

Protection Opportunities data combine existing protected areas, condition data, threats, partner interest, and likely presence of species of concern to support resource allocation decisions (see p. 4). Patches ranked as low are small and widely distributed across the Coastal Plain, with those ranked high or very high more common on the western edge.

CONDITION STATUS

Acreage available to:

RESTORE: 7.2 million

ENHANCE: 31.4 million

MAINTAIN: 2.5 million

PROTECTION STATUS

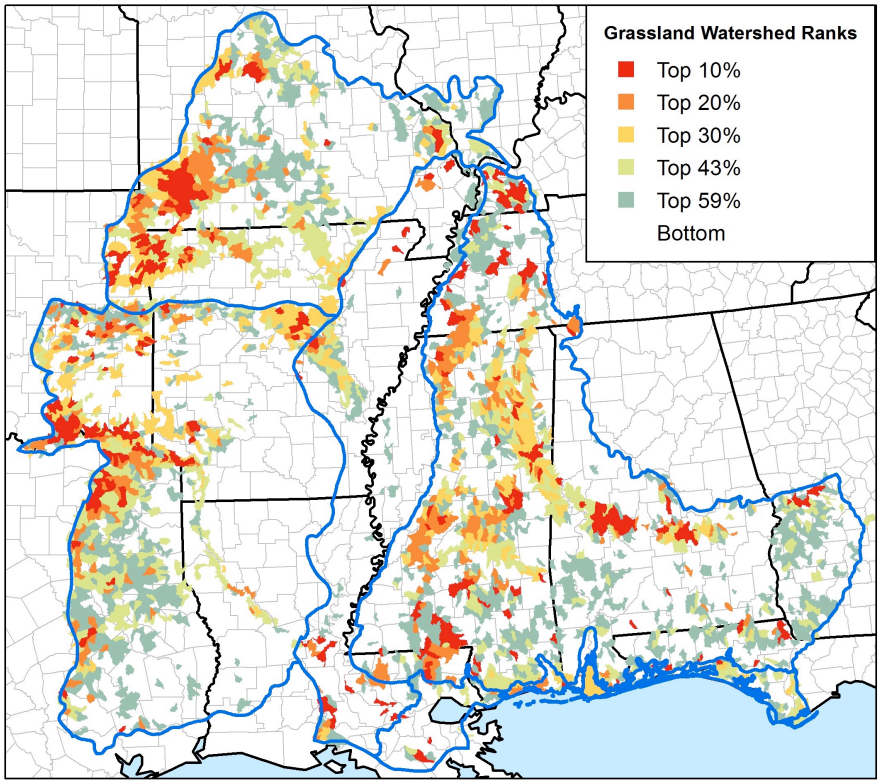
1.6 million acres already protected

0.6 million acres ranked as high opportunity for protection

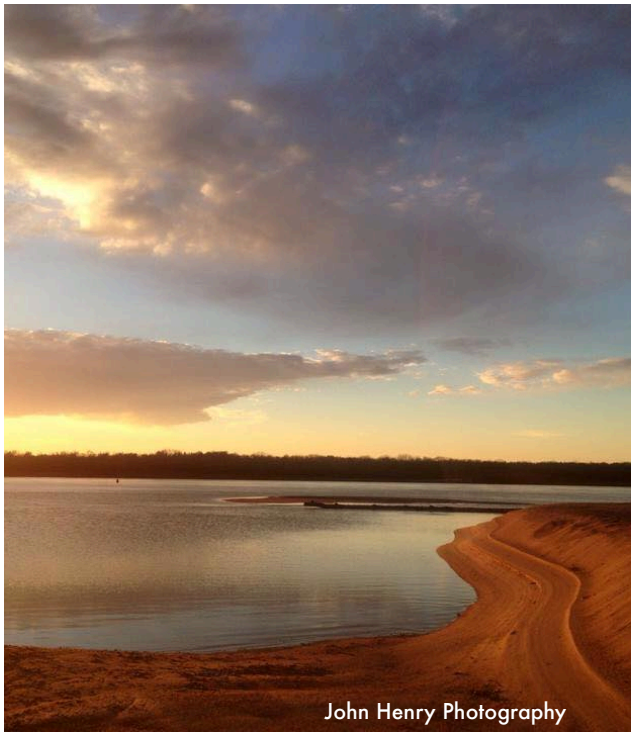
23 thousand acres ranked as very high opportunity for protection

Our **Grassland Watershed Ranks** blueprint map estimates the relative condition of watersheds within sub-geographies based on the amount of existing grasslands and the proportion of grasslands in desired condition.

Where are our best opportunities for achieving desired conditions?



Mainstem "Big River" Systems


John Henry Photography

Desired Condition: *Large river systems and their associated floodplains have water quality and adequate seasonal high and low flows with a frequency and duration sufficient to ensure connectedness across the diversity of habitat types.*

The Gulf Coastal Plains and Ozarks region is, to a large extent, defined by its mainstem big rivers, with eight of the largest ten rivers (by discharge) in the lower U.S. terminating here. Those rivers are the Mississippi, Ohio, Missouri, Tennessee, Mobile, Atchafalaya, Red, and Arkansas.

Ecological Assessment

Our assessment defined big rivers as those having an average annual flow of at least 6,000 cubic feet/sec (cfs). This definition also captured portions of the Sabine, Trinity, White, and Pearl among others.

Our analysis produced a Condition Index from the input data sets that showed most segments of these rivers lack sandbars, side channels, and deep water refugia on the floodplains. Most mainstem segments assessed here lack dams, though they are impacted by dams upstream. Spatial datasets used with confidence include the GCPO LCC's Inundation Frequency assessment and its derivatives, NLCD, and the National Inventory of Dams. However, the assessment is clearly biased toward the Mississippi River, and all data need to be further validated against reference data to improve reliability.

Overall Appraisal of Conservation Targets and Datasets Used to Assess Them
(see page 3 for information about this table)

Value Interpretation	Needs Improvement → Good				
	1	2	3	4	5

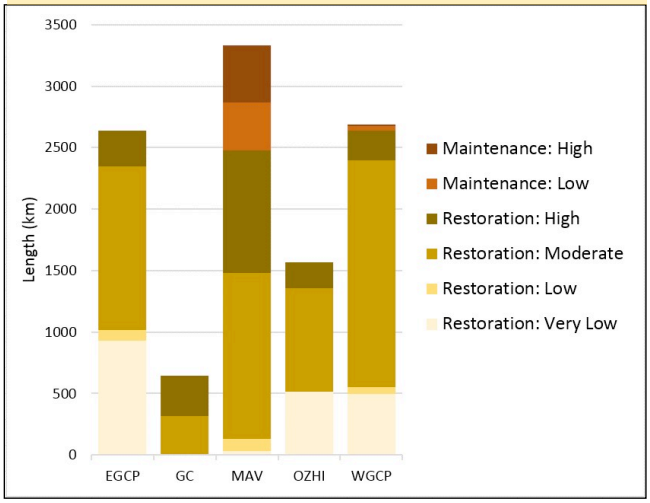
Conservation Target (from Integrated Science Agenda)	Target Assessment		Data Assessment		Average
	Specificity	Utility	Relevance	Rigor	
Maintain current river miles	5	5	5	5	5
Connectedness that ensures accessibility of habitats and resources within a watershed	1	1	1	1	1
Lateral connectedness: functional connectivity to floodplain habitats	1	5	5	5	4
Linear connectedness: functional connectivity of a stream network	1	3	1	1	1.5
Water quality: temperature below critical threshold	1	1	1	1	1
Water quantity: Adequate magnitude with limited frequency of low flows conditions	1	3	3	3	2.5
Intact channel morphologies: natural riffle-pool sequences	1	1	1	1	1
Intact channel morphologies: Meandering channels with natural sinuosity	1	5	5	5	4
High physical structure complexity: High amounts of small woody debris	1	3	3	3	2.5
High physical structure complexity: Adequate amounts of large woody debris	1	1	1	1	1
High physical structure complexity: Diversity of substrates, including numerous gravel beds and sandbars	1	1	1	1	1
Average	1.4	2.6	2.5	2.5	2.2

Conservation Blueprint

Management Opportunities data describe recommended management actions derived from the condition index at 2 spatial scales: Instream and Floodplain. At the Instream scale, **Maintain** indicates the presence of natural flow regimes creating a diversity of habitats, whereas **Restore** indicates one or more watershed or site targets are not met (see page 3). Good condition segments only occur on the Mississippi River, primarily between Memphis and Vicksburg. At the Floodplain scale, **Maintain** indicates floodplain habitat conditions and connectedness targets are met regardless of watershed or site status, whereas **Restore** indicates one or more condition targets are not met (see page 3). Good condition segments occur across the big rivers of the GCPO but are concentrated on the Mississippi River.

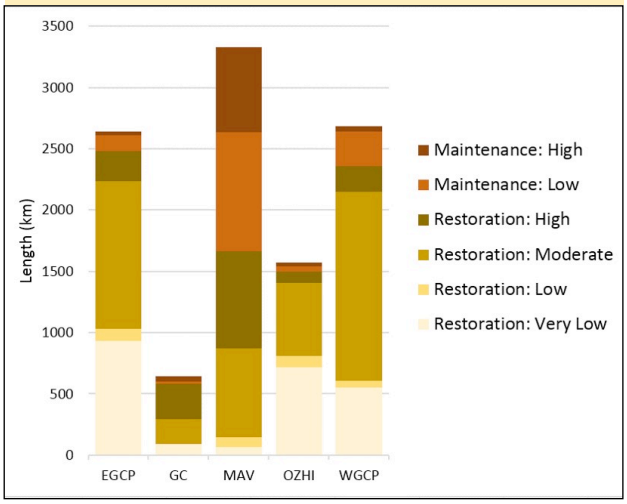
Mainstem Big Rivers Instream

Are there a diversity of riverine habitats in the watershed & is the river unimpounded?



Mainstem Big Rivers Floodplain

How well connected are a variety of floodplain habitats?



INSTREAM STATUS

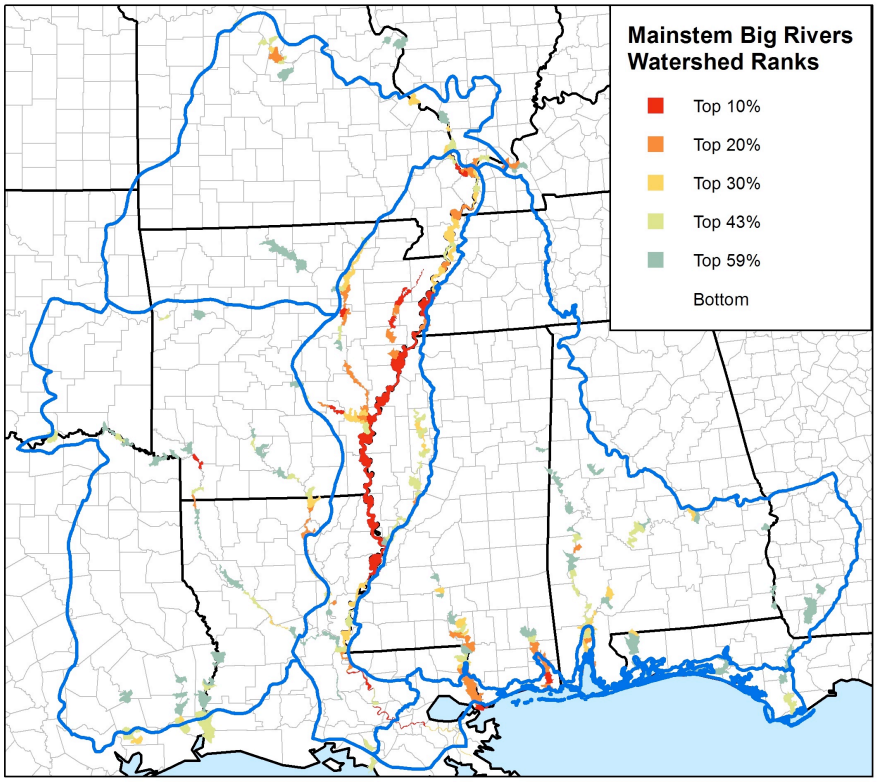
Acreage available to:
RESTORE: 6,754 river miles (92%)
MAINTAIN: 559 river miles (8%)

FLOODPLAIN STATUS

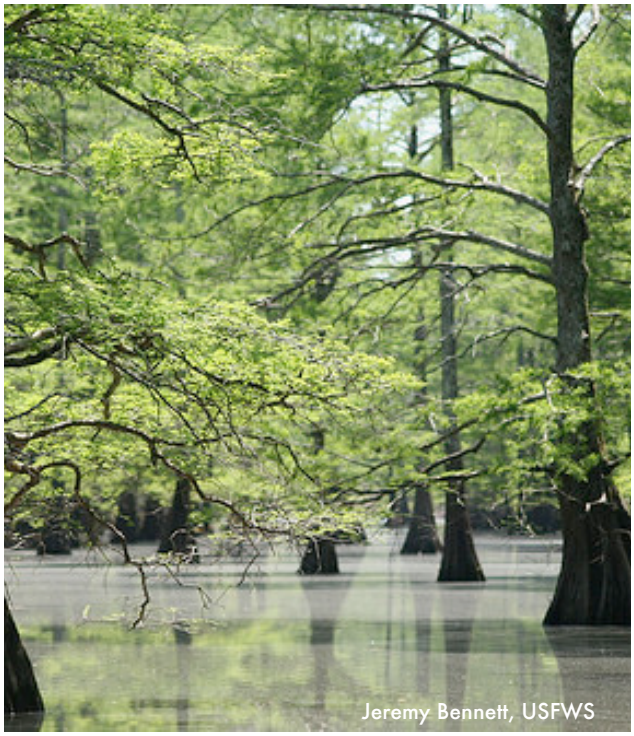
Acreage available to:
RESTORE: 5,331 river miles (79%)
MAINTAIN: 1,422 river miles (21%)

Our **Mainstem Big Rivers Watershed Ranks** blueprint map estimates the relative condition of watersheds across the GCPO region based on the length of river segments rated Maintain or Restore.

Where are our best opportunities for achieving desired conditions?



Forested Wetlands


Jeremy Bennett, USFWS

Desired Condition: *Local landscapes that are extensively forested with large contiguous patches of forest with a naturally diverse canopy containing a floristic diversity within the midstory and understory.*

The Mississippi River alluvial floodplain formerly held one of the largest expanses of bottomland hardwood forest in North America. It is also one of the most impeded systems on the continent, with altered hydrology from a vast network of protection levees and most naturally occurring bottomland forests long ago converted to agriculture across the majority of the Mississippi Alluvial Valley (MAV).

Ecological Assessment

This assessment used areas of agreement across multiple data layers as a basis for identifying forested wetlands. This composite approach found an estimated 4.6 million acres of forested wetlands in the MAV and 12.9 million acres in the entire GCPO region. These forested wetlands are in a variety of conditions, with less than half a million acres meeting most of the conservation targets, and a third of these on protected land.

Overall Appraisal of Conservation Targets and Datasets Used to Assess Them
(see page 3 for information about this table)

Value Interpretation	Needs Improvement → Good				
	1	2	3	4	5

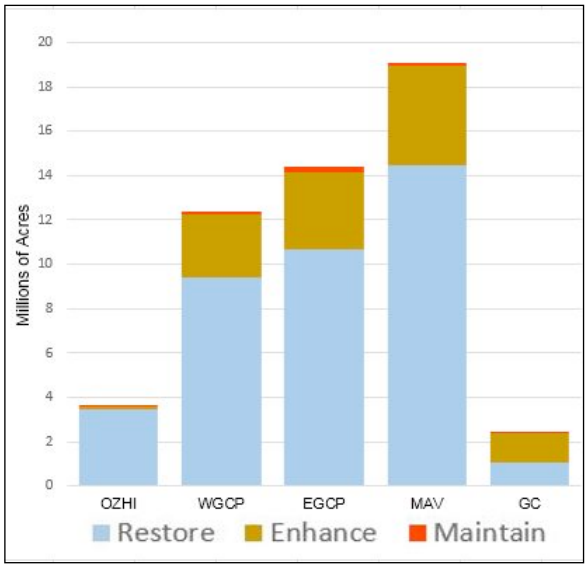
Conservation Target (from Integrated Science Agenda)	Target Assessment		Data Assessment		Average
	Specificity	Utility	Relevance	Rigor	
3.7 million acres	5	5	3	5	4.5
70-100% forested within 10,000 acre landscape	5	5	3	5	4.5
13 patches >100,000 acres	5	5	5	5	5.0
36 patches >20,000 acres	5	5	5	5	5.0
52 patches >10,000 acres	5	5	5	5	5.0
Overstory canopy cover 60-70%	5	5	5	5	5.0
Midstory cover 25-40%	3	3	3	3	3.0
Understory cover 25-40%	3	3	1	1	2.0
Basal area 60-70 square feet/acre	5	3	5	3	4.0
Tree stocking 60-70%	5	3	3	3	3.5
Large snag density: 0.2/acre of snags >= 26" dbh	5	3	3	3	3.5
Diverse tree species composition	3	3	3	3	3.0
Cane & vine occurrence	3	1	1	1	1.5
Natural flow & periodicity	3	3	3	5	3.5
An appropriate distribution of successional stages, with <10% of local landscape in early successional stage at any given time	3	3	3	3	3.0
Potential forested wetlands (LANDFIRE BpS)	3	3	5	5	4.0
Average	4.1	3.6	3.5	3.8	3.8

Conservation Blueprint

The **Management Opportunities** data product describes recommended management actions: **Restore** means appropriate for habitat but currently in another use; **Enhance** means habitat exists out of conditions; and **Maintain** means >1 condition target present across all patch size/configuration classes (see p. 3). Nearly the entire floodplain of the MAV is in the **Restore** class, with greater opportunities in proximity to existing forest.

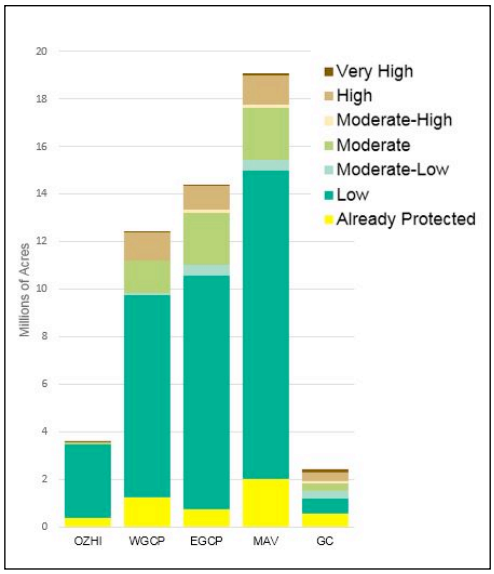
Forested Wetland Management Opportunities

How much of the landscape meets targets for desired conditions?



Forested Wetland Protection Opportunities

How much of the landscape is protected or high opportunity for protection?



Protection Opportunities

The **Protection Opportunity** data product combines existing protected areas, condition data, threats, partner interest, and likely presence of species of concern in varying combinations to support resource allocation decisions (see p. 4). Conservation opportunities are widespread across the region and predictably sparse north of the fall line.

CONDITION STATUS

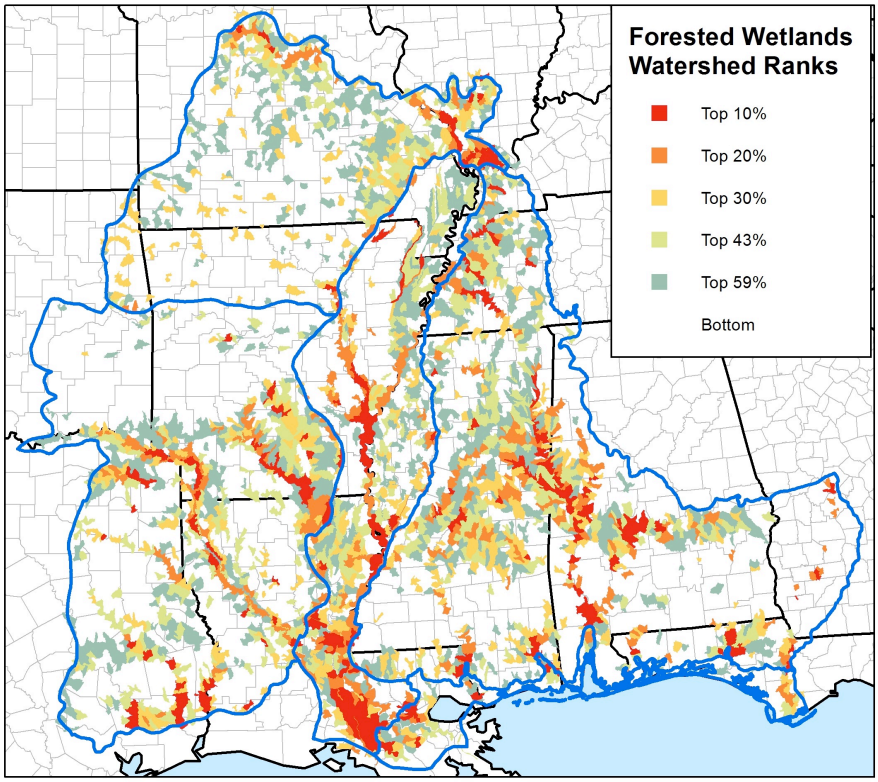
Acreage available to:
RESTORE: 39 million
ENHANCE: 12.2 million
MAINTAIN: 0.6 million

PROTECTION STATUS

4.9 million acres already protected
3.8 million acres acres ranked as high opportunity for protection
0.3 million acres ranked as very high opportunity for protection

Our **Forested Wetland Watersheds Ranks** blueprint map estimates the relative condition of watersheds within subgeographies based on the amount of existing forested wetlands and the proportion in desired condition.

Where are our best opportunities for achieving desired conditions?



Gulf Coast Tidal Marsh

Desired Condition: *Stable marsh systems comprised of native vegetation and limited open water conditions occurring in large blocks with natural hydrology present.*

The Gulf of Mexico is estimated to contain nearly half of all U.S. salt marsh systems, which are rapidly disappearing within the Gulf States due to a combination of sea level rise, subsidence, and land conversion. Salt marshes are complex, dynamic, and transitional systems that provide habitat for a myriad of wildlife species, filtration that supports water quality, and natural barriers that contribute to the security of inland coastal areas. Loss of coastal wetlands and degradation of estuarine habitat along the northern Gulf of Mexico, and particularly along coastal Louisiana, have been recognized as two of the primary issues influencing Gulf ecosystem integrity.

Ecological Assessment

Using data provided by the U.S. Geological Survey and state of Florida, we estimate 202,584 acres of estuarine tidal marsh exists along the GCPO LCC Gulf Coast, 73% of which is located within large patches >250 acres. The assessment also identified about a million acres of current potential tidal marsh plus future potential tidal marsh under a moderate sea level rise and marsh migration scenario.

Overall Appraisal of Conservation Targets and Datasets Used to Assess Them
(see page 3 for information about this table)

Value Interpretation	Needs Improvement → Good				
	1	2	3	4	5

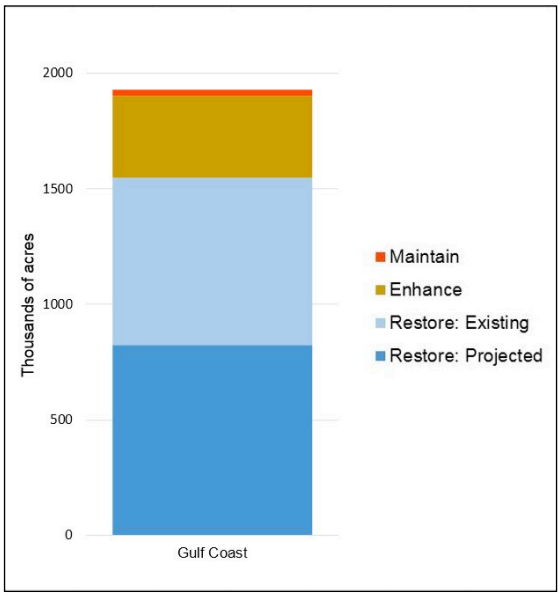
Conservation Target (from Integrated Science Agenda)	Target Assessment		Data Assessment		Average
	Specificity	Utility	Relevance	Rigor	
Adequate acres to meet needs of tidal wetland wildlife at desired levels; no loss.	3	5	5	5	4.5
Large blocks of unbroken marsh (> 250 acres)	5	5	5	5	5.0
Connectivity of habitat types reflective of interdigitation of marsh types	3	3	3	3	3.0
Moderate amounts of edge within large blocks of marsh	1	5	5	5	4.0
Presence of barrier island in riverine-dominated systems	1	3	5	5	3.5
Structure: Emergent vegetative cover: >70%	5	5	5	5	5.0
Structure: Limted open water: <20%	5	3	5	5	4.5
Structure: Submergent vegetative cover: 15-30%	5	3	3	3	3.5
Composition: Dominated by native plants typical of high, mid, intermediate, and low marsh	1	1	1	1	1.0
Water quality: Salinity: Aligned along a natural gradient	1	3	3	3	2.5
Water quantity: Adequate freshwater flows and tidal influence	1	1	1	1	1.0
Average	2.8	3.4	3.7	3.7	3.4

Conservation Blueprint

The **Management Opportunities** data product describes recommended management actions: **Restore** means appropriate for habitat but currently in another use; **Enhance** means habitat exists out of conditions; and **Maintain** means >1 condition target present across all patch size/configuration classes (see p. 3). For Tidal Marsh, **Restore** identifies both existing areas and potential future areas under a moderate sea level rise and marsh migration scenario.

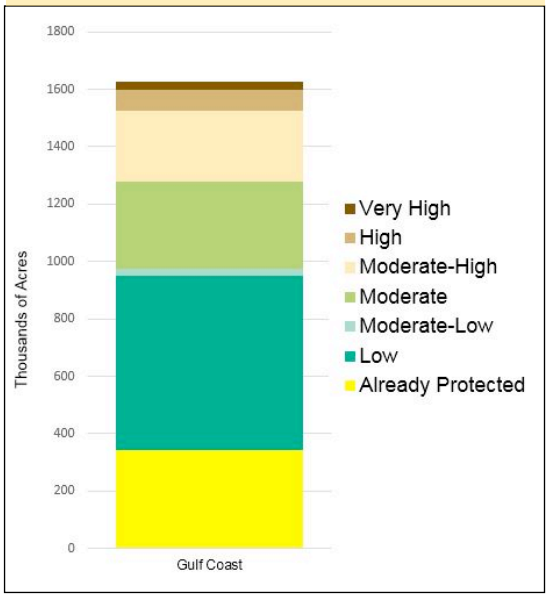
Tidal Marsh Management Opportunities

How much of the landscape meets targets for desired conditions?



Tidal Marsh Protection Opportunities

How much of the landscape is protected or high opportunity for protection?



Protection Opportunities

The **Protection Opportunity** data product combines existing protected areas, condition data, threats, partner interest, and likely presence of species of concern in varying combinations to support resource allocation decisions (see p. 4). Areas of potential habitat in proximity to large patches of existing habitat are included in the "already protected" class.

CONDITION STATUS

Acreage available to:

RESTORE: 826 thousand current, 724 thousand projected
ENHANCE: 351 thousand
MAINTAIN: 28 thousand

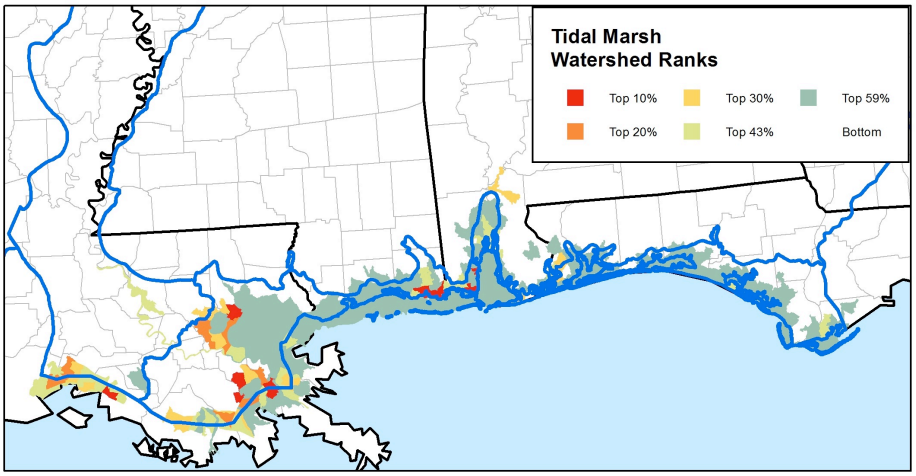
PROTECTION STATUS

345 thousand acres of pine forest already protected

73 thousand acres ranked as high opportunity for protection

27 thousand acres ranked as very high opportunity for protection

Where are our best opportunities for achieving desired conditions?



Our **Tidal Marsh Watershed Ranks** blueprint map ranks Gulf Coast watersheds according to quantity and quality of tidal marsh habitat. Our top-ranked watersheds are in Louisiana and the Grand Bay/Mobile Bay area of Mississippi and Alabama.

Gulf Coast Beaches and Dunes

Desired Condition: *Stable, vegetated dune systems (including primary and secondary dunes) along intact, wide beaches with limited human disturbance.*

Natural and man-made disasters combined with growing concern about sea level rise have led to a recent emphasis on the resiliency of natural and human communities along the Gulf Coast. Beach and dune systems have been shown worldwide to reduce deleterious effects of extreme events. These dynamic shorelines also provide opportunities for recreation and wildlife habitat, making them a critical nexus for socioeconomic and ecological priorities.

Ecological Assessment

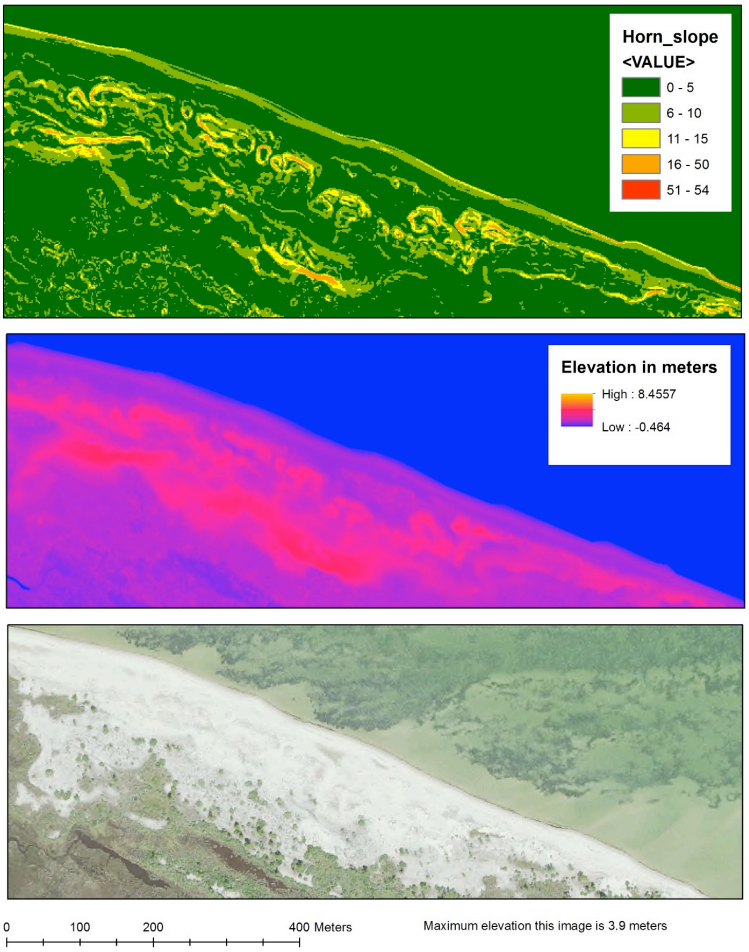
The capacity of beach and dune systems to protect communities and support ecosystem function depends on the interactions of morphological and vegetative characteristics of the dunes themselves. A comprehensive geospatial assessment of these characteristics along the northern Gulf of Mexico coastline has historically been challenged by a lack of high-resolution elevation and vegetative composition data. In addition, the highly dynamic nature of the system and episodic severe wind and surge events combine to present formidable challenges to mapping dune systems.

Recently, advances in high-resolution LiDAR elevation data, coupled with high-resolution multi-spectral imagery data, provide an opportunity to map dune geomorphology and vegetative structure at submeter resolution. This unprecedented understanding of dune peaks, ridges, shoulders, slope, valley, flats, and depressions can inform how they change over time and in response to episodic and incremental events. Work is currently underway that compiles high-resolution 2015-2016 elevation and imagery data to produce a comprehensive map of dune geomorphology and vegetation structure across the GCPO LCC coastline to quantify LCC conservation targets as well as address species-habitat relationships in dunes. These map products will inform future iterations of the Ecological Assessment and Conservation Blueprint.

Overall Appraisal of Conservation Targets and Datasets Used to Assess Them
(see page 3 for information about this table)

Value Interpretation	Needs Improvement → Good				
	1	2	3	4	5

Conservation Target (from Integrated Science Agenda)	Target Assessment		Data Assessment		Average
	Specificity	Utility	Relevance	Rigor	
Functional connectivity of beach and dune systems	1	3	3	3	2.5
Disturbance: no unfettered access to dunes	3	3	3	3	3
Structure: Presence of primary, secondary, and tertiary dunes, where appropriate	1	3	1	1	1.5
Structure: Vegetative cover 20-50%	5	5	1	1	3
Structure: Dune width 10-20'	3	1	1	1	1.5
Structure: Dune height: Primary 2-4', Secondary 4-6', Tertiary >6'	3	1	1	1	1.5
Structure: Dune slope: 18-45 degrees	5	5	1	1	3
Composition: Presence of sea oats, bitter panicum, and spartina patens	5	1	1	1	2
Average	3.3	2.8	1.5	1.5	2.3



At left: *Sub-meter slope, elevation, and vegetation data provided by LiDAR and high resolution multi-spectral imagery can inform a dune morphology mapping process.*

Above: *Dunes on St. George Island, Florida*

Below: *Large dunes with mangrove and pine communities at Tyndall Air Force Base. These dunes provide habitat for the endangered St. Andrew Beach Mouse.*

All photos by Kristine Evans.

Future Directions

This document summarizes what we currently know about local and landscape conditions within the Gulf Coastal Plains & Ozarks region. As such, it represents a milestone in the GCPO LCC's quest to "ensure natural and cultural landscapes capable of sustaining healthy ecosystems, clean water, fish, wildlife and human communities through the 21st century." We clarified our definitions of what we want by identifying desired conditions for focal habitat systems within the Integrated Science Agenda (ISA). Through the Ecological Assessments and Conservation Blueprint efforts, we pulled together or generated a large quantity of data to tell us how current conditions compare to those desired conditions.

Yet there is much more work to do. To fulfill its namesake, the LCC's Conservation Blueprint needs to evolve from an assessment of current condition into a roadmap for applying adaptation strategies. This evolution will be achieved by focusing efforts on 3 fronts: refining the Blueprint, using the Blueprint to develop a Strategic Conservation Framework, and strengthening the partnership.

REFINING THE BLUEPRINT

We used an iterative, rapid prototyping approach to develop Blueprint 1.0. It isn't perfect or finished, but by taking this approach we could test drive the product by applying it to real-world decisions. We are currently building these early "use cases" to figure out which potential improvements are most crucial. Some likely areas of refinement include:

- Updating the ISA based on the data assessment tables in this document, as well as recent research, including that funded by the LCC
- Refining species lists in the ISA and improving species data included in the Blueprint
- Refining and/or adding additional habitat systems to the ISA (e.g. splitting Open Pine into Longleaf and Shortleaf systems with associated species and adding a Freshwater Marsh system)
- Incorporating assessments for cultural resources using guidance from LCC-funded research
- Ensuring terminology and assessments are consistent

STRATEGIC CONSERVATION FRAMEWORK

LCCs intend for tools such as the Ecological Assessments and the Blueprint to support common resource allocation decisions across partners in a consistent way. To do this effectively, we need to derive products from the Blueprint that speak specifically to those decisions in a transparent, repeatable, and defensible (i.e. scientific) way. Static maps of the current Blueprint achieve this objective but are not particularly useful for identifying effective adaptation strategies. Therefore, we are working to develop dynamic tools that combine the habitat assessments with species models in a framework that allows users to proactively explore the impacts of potential landscape changes and land management decisions. Such tools will improve the efficiency and effectiveness of conservation actions.

PARTNERSHIPS

We cannot achieve the landscape conservation vision without strong partnerships, and there is room for improvement both internally with existing partners and externally with other organizations that shape the region's landscapes. The snapshot presented in these pages tells us as much about how far we've come as a partnership as how much conservation we need to achieve our vision. The information in this document was produced through the input of hundreds of people representing dozens of organizations. We have produced a common framework and lexicon that reaches across socio-political and ecological boundaries. This was a major accomplishment and bodes well for the future of the partnership and the resources we love.

Acknowledgments

We would like to thank the more than 175 people from at least 50 organizations involved in reviewing, revising, and providing data for the ecological assessments and blueprint development. We would also like to thank the more than 60 scientists who conducted research supported in whole or in part by the GCPO LCC to provide additional information critical to the ecological assessments and landscape conservation design process. Thank you.

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Photo credits

Front page, left to right:

Ozarks igneous glade habitat-Paul Nelson; Open pine at Mississippi Sandhill Crane NWR-Toby Gray; **Harrell Bayou kayaker**-finchlake 2000; **Indian Pass, Florida panhandle**-Nicole Rankin, USFWS

Back page, clock wise from top:

Earth-NOAA/NASA GOES project; Boy with fish in TN-Ron Jones (Flickr Creative Commons); **Logging with Ponsse Ergo**-Wyatt Bros.; Arkansas hunter and dog-Keith Sutton; **Ocala National Forest prescribed burn**-USDA; **Birders on marsh**-Tim Lenz; Farmer in native warm season grass planting-George Dept. of Natural Resources