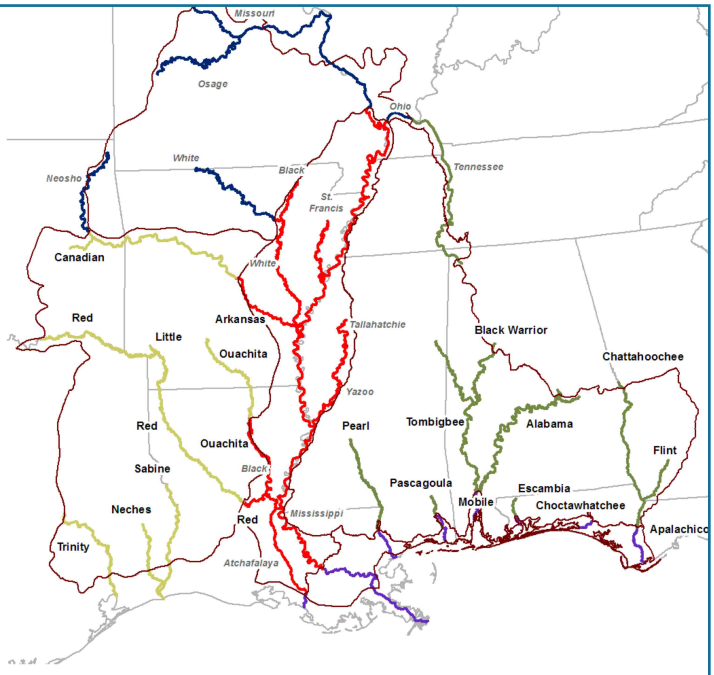
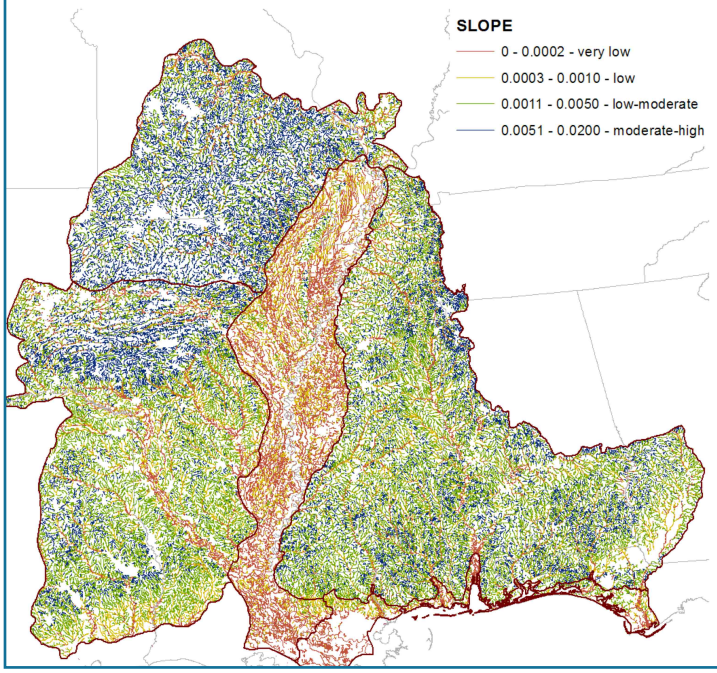
DRAFT **Medium to low gradient streams and rivers in the East and West Gulf Coastal Plains (EWGCP)**





From the Executive Summary of the 2016 State of the GCPO

GCPO
Gulf Coastal Plains & Ozarks
Landscape Conservation Cooperative

SUMMARY

PHOTOS, CITATION, ACKNOWLEDGEMENTS

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Ouachita River - Robert Nunnally; Mainstem big rivers of the GCPO region - Yvonne Allen, USFWS/GCPO LCC; Apalachicola River, Chris M. Morris; Distribution of medium-low gradient streams in the GCPO - Yvonne Allen, USFWS/GCPO LCC

Photo Credits in Text

p. 5, A soothing sound in Pinson (riffle) - André Natta; p. 6, Kirk Gardner helps a student with a D net (gravel- photo cropped) - USFWS Southeast

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The designation of “medium-low gradient streams and rivers” is very broad in that it relies on only gradient to define it. This designation includes a large proportion of rivers and streams throughout the EWGCP but excludes the smaller and steeper streams that are most abundant across the Ozark Highlands and Ouachita Mountains of the West Gulf Coastal Plain (WGCP), and at higher elevations of the East Gulf Coastal Plain (EGCP).

Within this broadly defined habitat type, landscape endpoints specified in the Integrated Science Agenda (ISA) describe localized stream amount, configuration and condition. These endpoints are further broken down into measures of sinuosity, temperature, riffle-pool sequences and physical structure composed of woody debris, leaf litter, and substrate types. Flows of these streams should be relatively steady, with infrequent periods of low water and relatively natural hydrology. Many of these waters will harbor primarily organisms adapted to warm water conditions. These physical attributes are generally shared across all medium-low gradient streams and rivers in the EWGCP, but species endpoints (not addressed here) are more likely to vary across river basins.

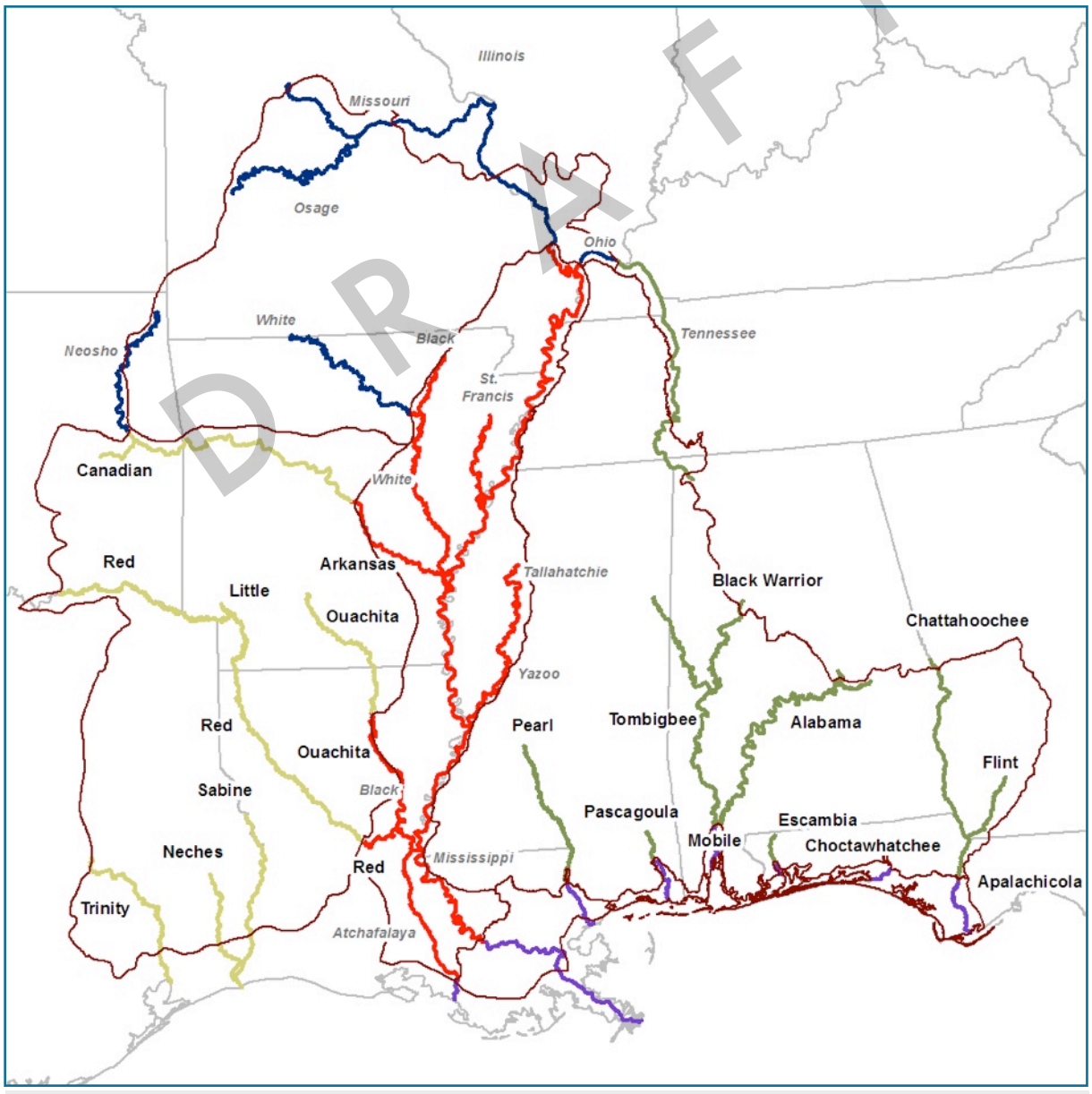

Figure 1. Distribution of mainstem big rivers within the subgeographies of the GCPO LCC. EWGCP rivers and streams are shown in bold.

Summary of Findings for Landscape Endpoints

AMOUNT

Current river miles

The ISA landscape endpoint is to maintain current river miles. There are no distinct geographic patterns in the distribution of medium-low gradient streams within the EWGCP subgeographies. Areas having low density of streams were frequently associated with the presence of a large reservoir. In the extreme southeast EGCP there is a lower density of streams where karst topography creates many sinkholes and subterranean streams. The total kilometers of medium to low gradient streams in the EWGCP is 205,812 km (EGCP=111,727 km and WGCP=94,085 km). Estimates normalized to area within each subgeography are approximately the same, approximately 0.44 km/km^2. (Figure 2)

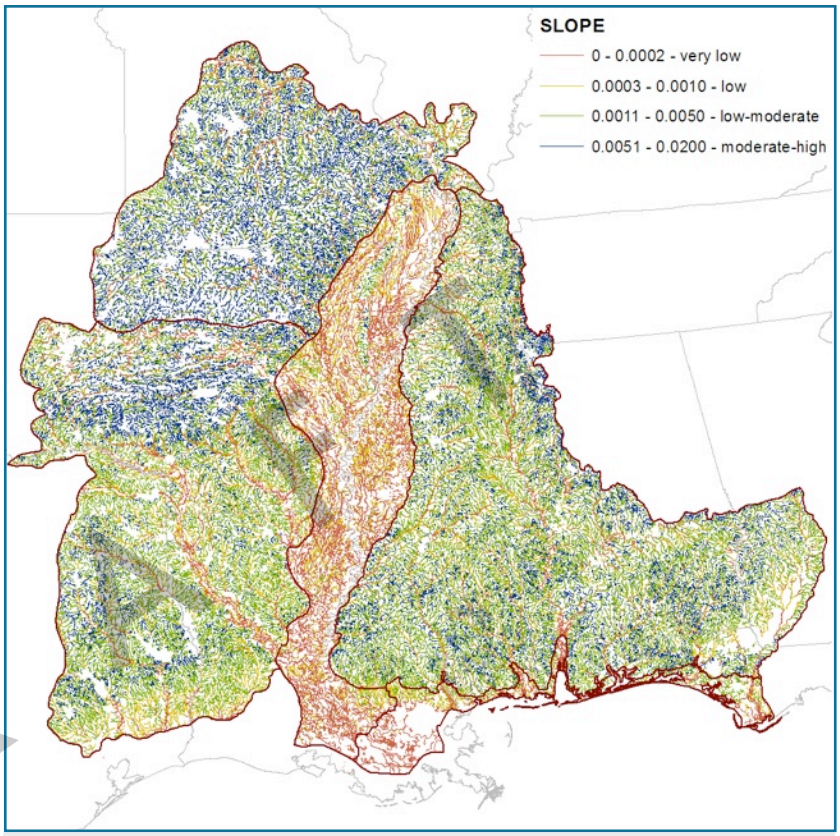

Figure 2. Distribution of medium to low gradient streams and rivers within the subgeographies of the GCPO LCC.

CONFIGURATION

Lateral connectivity to floodplain habitats

The ISA landscape endpoint is to maintain functional connectivity to floodplains. Floodplains are defined as areas with intermittent inundation from 10% to 90% of the time. Approximately 97% of intermittent inundation in the EWGCP is associated with riverine systems, in contrast to the MAV, where 40% is associated with agriculture. In the EGCP, the largest of these is the upper Mobile River Basin. In west Tennessee, extensive floodplains are associated with the Hatchie, Obion, and North and South Forked Deer Rivers. Coastal rivers including the Pearl, Pascagoula, Escambia, Choctawhatchee and Apalachicola Rivers also have significant floodplain systems. In the WGCP, extensive floodplain areas are associated with the Ouachita River especially on the Felsenthal National Wildlife Refuge and on the Sulphur River in Arkansas and Texas. (Figure 3)

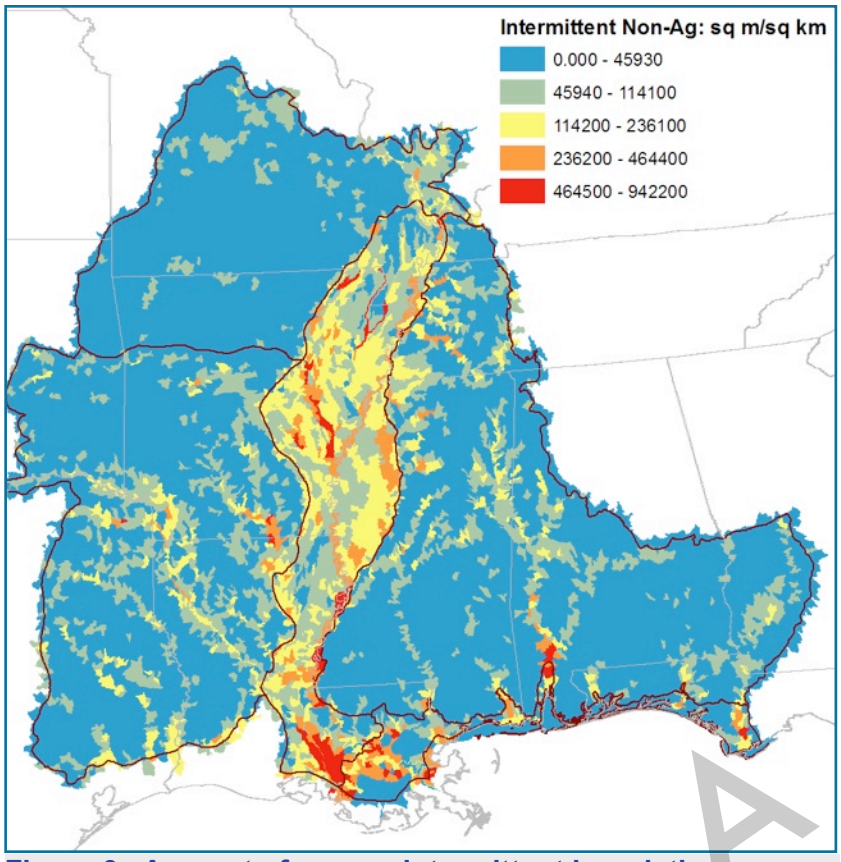

Figure 3. Amount of non-ag intermittent inundation (10-90%) normalized by the total area in a given watershed.

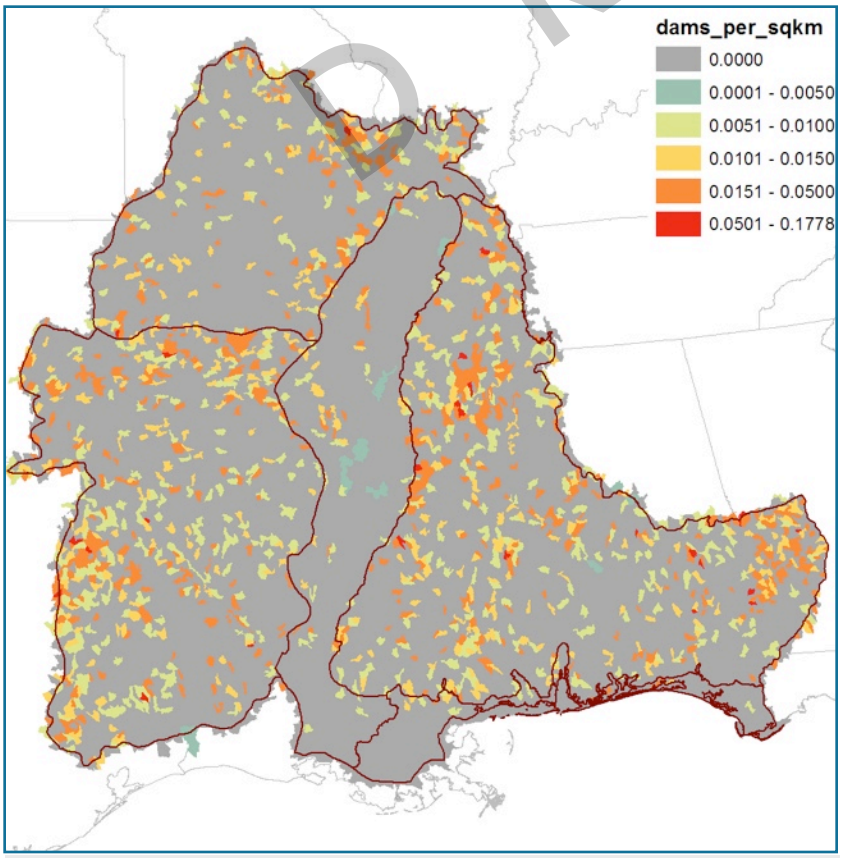

Figure 4. Abundance of dams normalized by area within watersheds (HUCs) of the GCPO.

Linear connectivity of a stream network

The ISA landscape endpoint is to maintain functional connectivity of a stream network. EWGCP is 205,812 km (EGCP=111,727 km and WGCP=94,085 km).

Southeastern rivers contain the largest number of at-risk freshwater fish and invertebrates than any other region of the country. The presence of dams and other man-made barriers fragment the river network, contributing to habitat loss, impeding movement, and negatively affecting freshwater biodiversity. The South Atlantic LCC (SALCC) recently funded the Southeast Aquatic Connectivity Assessment Program. This assessment will provide a more comprehensive inventory of barriers to linear aquatic connectivity and their potential impacts on species of concern within the South Atlantic region. Preliminary results from this assessment found almost four times the number of barriers indicated in the 2012 National Anthropogenic Barriers Database, the basis for the GCPO analysis. (Figure 4)

CONDITION

Water quality: temperature

The ISA landscape endpoint is to maintain temperature below the critical threshold (for species). Air temperatures can be used as a surrogate for stream temperature in the absence of widespread instream temperature monitoring. The maximum August air temperature ranges observed in the EWGCP (from 1981 to 2010) correspond with lethal thermal tolerance limits for the most heat-tolerant of cool water species and all warm water species. Pockets of cooler water exist in some medium-low gradient rivers and streams of the Ouachita Mountains in the WGCP (Mean August range: 26-27 degrees C), but most of the coolest water is associated with high-gradient streams. Mean August temperatures were highest in east Texas and the Red River Valley (28-29 degrees C). In the EGCP mean August temperatures are somewhat lower (26-27 degrees C) throughout most of the geography with slightly lower temperatures (25-26 degrees C) in parts of Tennessee and Kentucky. (Figure 5)

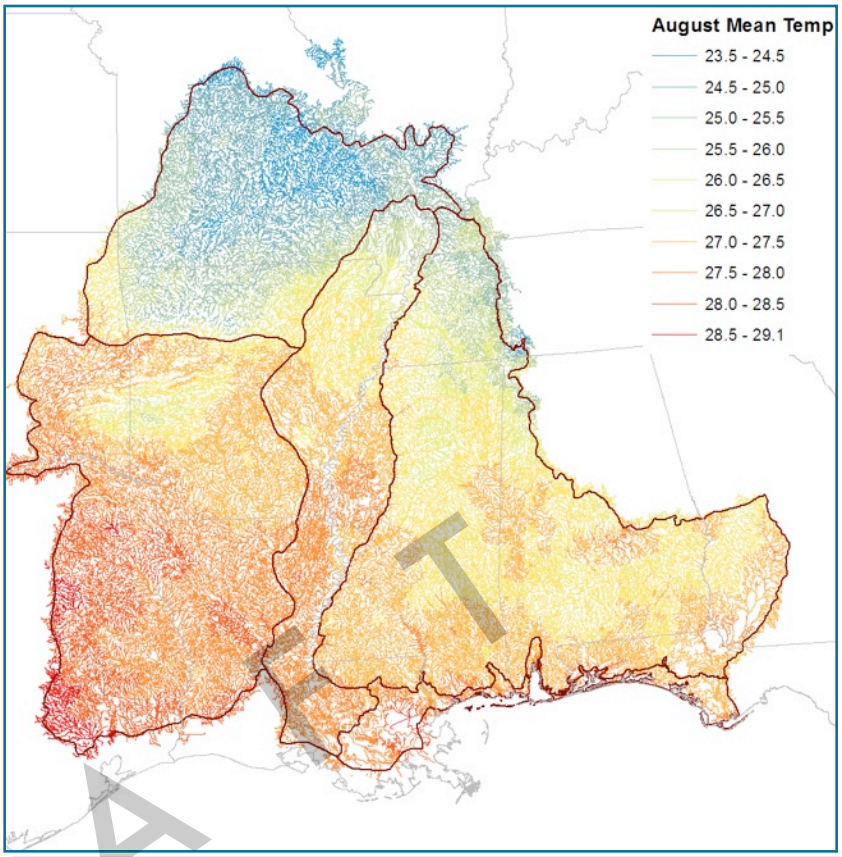

Figure 5. Long-term (1981-2000) August mean air temperature in degrees C for medium-low gradient streams and rivers.

Water quantity: magnitude

The ISA landscape endpoint is to maintain adequate magnitude with limited frequency of low flow conditions. Adequate variability in river flow is important because it is critical not only to maintain the physical habitat within the stream, but is also inextricably linked to water quality. Currently, appropriate geospatial data within the GCPO are lacking to *directly* establish natural levels of hydrologic variability. However, we used locations of cultivated cropland and the locations of impoundments to indirectly identify areas that may be affected by each of these stressors.

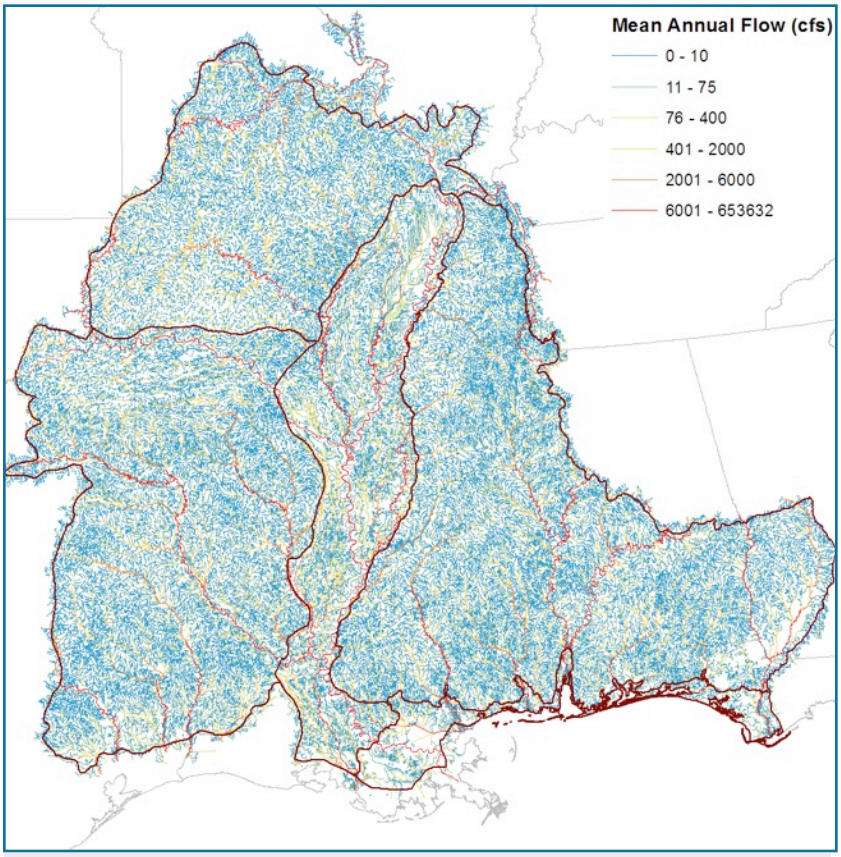

Figure 6. Mean annual flow for medium-low gradient streams and rivers in the GCPO

Within the EGCP, areas of widespread cultivated cropland are located in southeast Georgia, southwest Alabama, northern Mississippi, western Tennessee and western Kentucky. Within the WGCP, there is abundant agricultural activity but most is pasture and hay (which we assumed do not require irrigation); cultivated crops are largely located in former floodplains along the Arkansas and Red River valleys. Impoundments are abundant throughout the the EWGCP and interrupt the flow of many medium-low gradient streams and rivers and their tributaries. (Figure 6)

Channel Structure: natural riffle-pool sequences

The ISA landscape endpoint is to maintain natural riffle-pool sequences. Even the most basic identification of the location of riffles and pools requires some bathymetric data, which is not available on a landscape scale in the GCPO.

Channel Structure: meandering channels with natural sinuosity

The ISA landscape endpoint to maintain meandering channels with natural sinuosity. In medium-low gradient streams and rivers, high sinuosity may be seen as a measure of increased available habitat diversity. Streams are frequently straightened to reduce localized flooding and increase navigability. This habitat alteration can reduce riffles, pools, and flow refugia and replace these habitats with more constant flow and homogenous depths, leading to shifts in aquatic community composition and species abundance. In the EGCP there is an elevated abundance of streams having very low sinuosity in western Tennessee and north Mississippi (10-40%), likely due to high channelization associated with extensive agricultural production in these areas. The remainder of the EGCP and the entire WGCP both have a higher percentage of streams with sinuosity. (The MAV by comparison has a very high degree of channelization, particularly in north east Arkansas and the boot heel of Missouri.) (Figure 7)

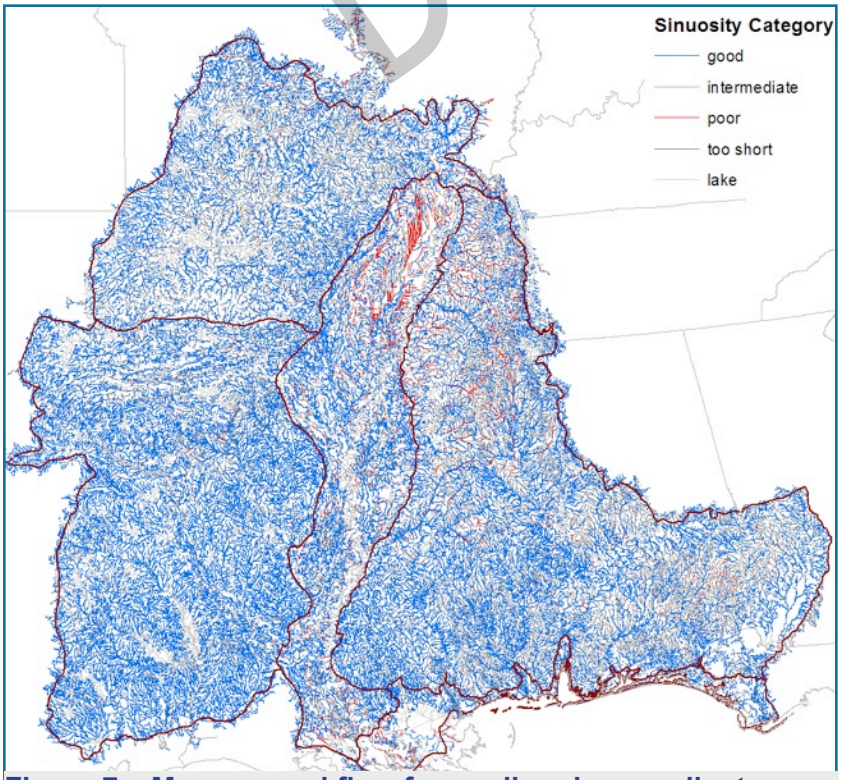

Figure 7. Mean annual flow for medium-low gradient streams and rivers in the GCPO

Structural complexity instream: amounts of small woody debris

The ISA landscape endpoint is to maintain high amounts of small woody debris (SWD). At this time, suitable landscape level data sources to characterize SWD could not be identified. SWD has been shown to provide structurally complex habitat that serves as refuge from predators and increases carrying capacity for trout fry. At a coarse level, the analysis of SWD may be similar to that of large woody debris, but SWD is less likely to be retained locally.

Structural complexity instream: amounts of large woody debris

The ISA landscape endpoint is to maintain adequate amounts of large woody debris (LWD). Overall, the landscape level patterns of potential LWD availability were similar for two sources of data employed. Both the EGCP and WGCP have high amounts of streams with greater than 80% forested riparian zones. The northern extent of the EGCP generally shows a lower abundance of forested riparian habitat with the consequence that the availability of LWD may be quite limited for stream segments in this region of the EGCP, compared with streams and rivers in the southern and eastern portions. Less riparian habitat is typically associated with agricultural production including row crops and hay/pasture. Similarly, low abundance of forested riparian habitat is found in the WGCP along the Arkansas and Red rivers in floodplain areas that have been converted to agricultural production. (Figure 8)

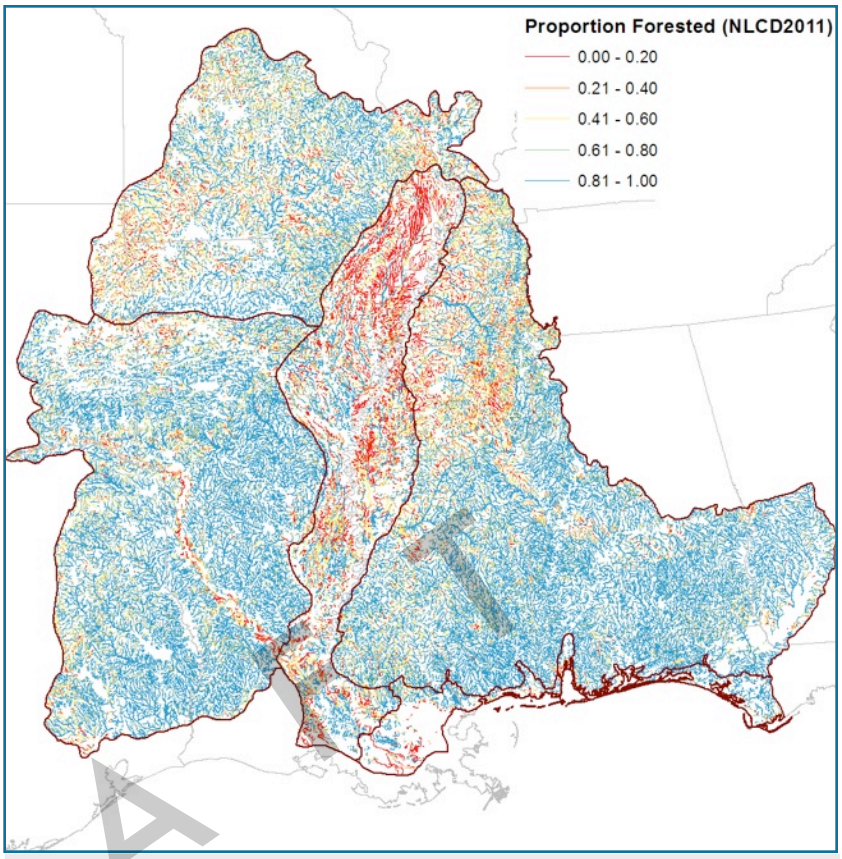

Figure 8. Proportion forested area in the riparian zone for smaller medium-low gradient streams.

Structural complexity instream: diversity of substrates, including gravel beds and sandbars

The ISA landscape endpoint is to maintain a diversity of substrates, including numerous gravel beds and sandbars. At this time, suitable landscape level data to characterize this landscape endpoint could not be identified.

Instream substrate composition is important to a wide variety of aquatic organisms, and factors that influence instream substrate include: local and landscape geology, topography, land use configuration, riparian conditions, and a stream's slope and discharge. Traditionally, sidescan sonar has been used to evaluate substrate composition on a broad scale. In recent years, several low-cost options using recreational grade sonar units have emerged that greatly improve the potential for developing more comprehensive aquatic habitat maps.

Summing it all up

The following tables present key summary statistics developed in the analysis of landscape endpoints for medium to low gradient streams in the entire GCPO region (EWGCP highlighted). They allow a side-by-side comparison of different parameters within and across subgeographies.

Medium-low gradient streams and rivers: amount and configuration summary (stream km, lateral and linear connectivity)

Geographic extent	Amount of current Medium-low gradient streams and rivers		Configuration: lateral connectivity to floodplain			Configuration: linear connectedness of a stream network		
	km	km/km² (in HUC12)	Total Intermittent inundation (km² in HUC12)	Intermittent non-Ag (km² in HUC12)	Intermittent non-Ag %	Count of dams	Dams/km² (HUC12)	Mean dam height (ft)
Mississippi Alluvial Valley	46,426	0.45	28,281	17,042	60	743	0.00349	19
East Gulf Coastal Plain	111,727	0.44	9,886	9,656	98	984	0.00956	21
West Gulf Coastal Plain	94,085	0.44	9,412	9,149	97	812	0.00320	33
Ozark Highlands	50,405	0.37	3,985	3,808	96	337	0.00247	42
Gulf Coast	9,186	0.37	3,342	3,340	100	14	0.00057	10
Gulf Coastal Plains and Ozarks (full extent)	309,064*	0.42	54,905	42,995	78	2890	0.00395	28

* Note that the total length of streams in each subgeography is based on stream segments touching the boundaries of the subgeography. A single segment that bridges two watersheds (HUCs) may be counted in each subgeography. The total length of streams for the entire GCPO is therefore less than estimates based on a sum of all subgeographies.

Medium-low gradient streams and rivers: condition summary
(water quality, quantity, structure and complexity)

Geographic extent	Km in the August mean temperature range (degrees Centigrade)			Amount of streams (km) in sinuosity categories			Percentage of smaller** streams by proportion of forested riparian (as source of LWD)				
	< 26	26-28	>28	Good	Intermediate	Poor	<0.2	0.2-0.4	0.4-0.6	0.6-0.8	>0.8
Mississippi Alluvial Valley	3,817	42,185	422	26,090	14,140	490	31%	13%	12%	13%	30%
East Gulf Coastal Plain	11,467	100,253	6	65,296	38,399	4,623	4%	6%	10%	17%	63%
West Gulf Coastal Plain	139	70,076	23,842	75,672	14,937	3,634	2%	4%	7%	19%	67%
Ozark Highlands	43,579	6,826	0	29,976	17,482	676	5%	10%	16%	25%	44%
Gulf Coast	0	8451	734	5,713	2,607	401	14%	4%	7%	13%	63%
Gulf Coastal Plains and Ozarks (full extent)	58,690*	225,396*	24,978*	200,552*	87,060*	9,777*	31%	13%	12%	13%	30%

* Note that the total length of streams in each subgeography is based on stream segments touching the boundaries of the subgeography. A single segment that bridges two watersheds (HUCs) may be counted in each subgeography. The total length of streams for the entire GCPO is therefore less than estimates based on a sum of all subgeographies.

** The analysis presented here is limited to smaller streams because the impact of LWD is more likely to remain local in streams having lower flow and smaller widths.