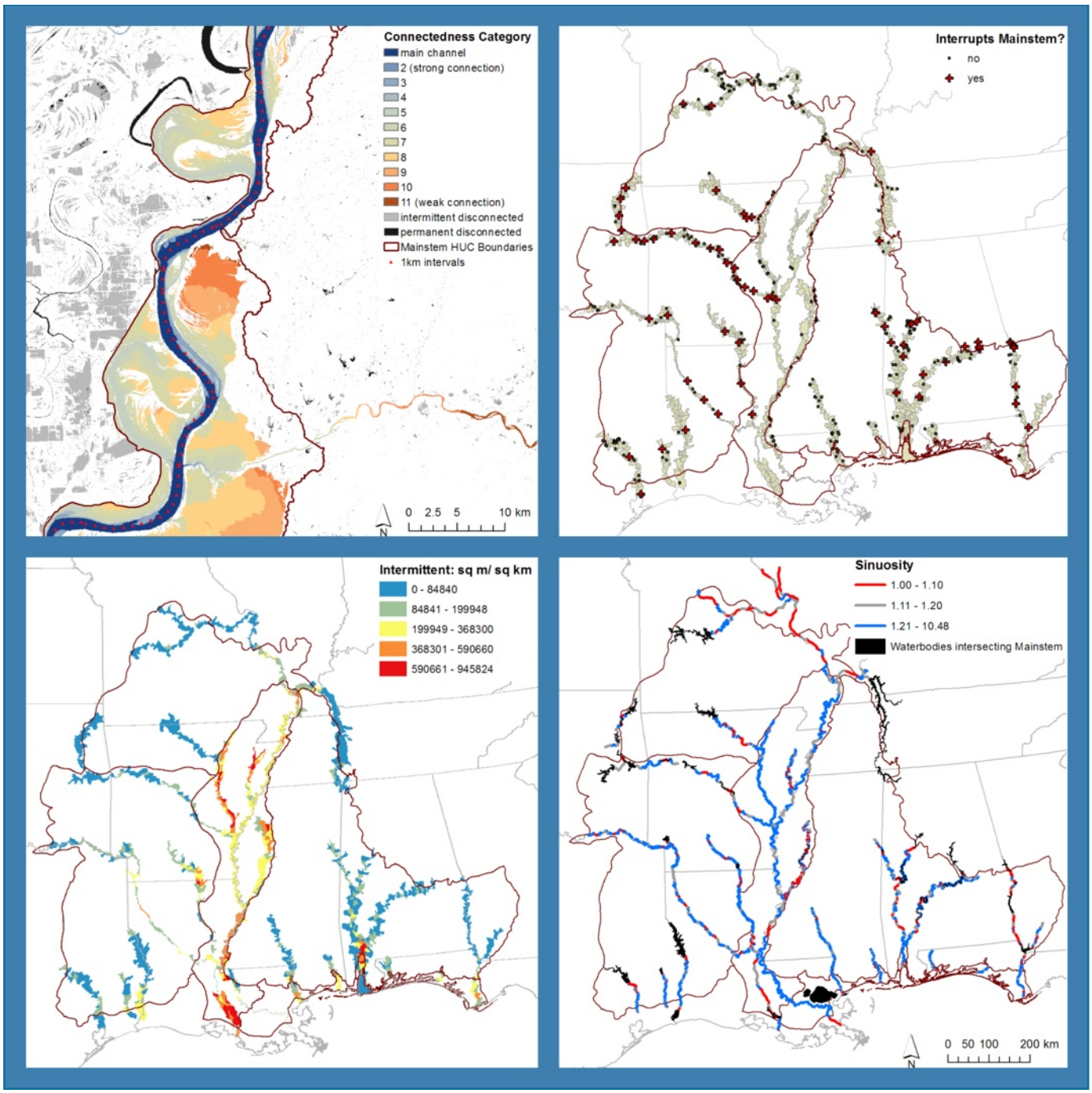
DRAFT **Main Stem Big Rivers**



From the Executive Summary of the 2016 State of the GCPO

GCPO
Gulf Coastal Plains & Ozarks
Landscape Conservation Cooperative

DRAFT SUMMARY

PHOTOS, CITATION, ACKNOWLEDGEMENTS

All Figures created by Yvonne Allen

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The Gulf Coastal Plains and Ozarks (GCPO) 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. While this assessment focuses on rivers of the MAV, the analysis has also been extended to big rivers throughout the GCPO.

People have historically altered large river systems through the construction of levees and floodways, channelization, and dredging to support agriculture, navigation, commerce, and to provide greater stability and protection from flooding. Many large rivers in the GCPO are, in fact, part of the inland commercial navigation network. Channel alterations have however impacted the ecological function of big rivers of the GCPO. One of the goals of this assessment is to define a suite of key characteristics that are important to good ecological functioning of large river systems and then identify locations where this suite of characteristics may be found in the GCPO.

The ISA landscape endpoints for mainstem big rivers are all qualitative as described in this summary's subheadings. An ongoing GCPO project led by the Southeast Aquatic Resources Partnership (SARP) is further refining the desired landscape and species endpoints for all the region's aquatic systems using available literature and expert opinion. In cooperation with early findings of the SARP funded project, the Assessment team also included additional indicators of habitat diversity including the abundance of sandbars, channel sinuosity, and floodplain vegetative cover type in addition to the ISA landscape endpoints.

Figure 1. Distribution of mainstem big rivers within the GCPO LCC. Names of mainstem big rivers in the MAV are indicated in bold. Location of federal protection levees in red.

NOVEL ANALYSES

To capture floodplain dynamics, this Assessment relies heavily on the GCPO's inundation frequency dataset (IF). The IF has been demonstrated to accurately characterize floodplain inundation under a variety of typical seasonal flooding scenarios. In addition, this Assessment uses a new analysis based on the IF to quantify the degree of lateral connectivity between the mainstem and the adjacent floodplain This new analysis may reveal important characteristics regarding not only floodplain extent , but also function, and thermal characteristics at the landscape scale. These two datasets represent a huge improvement in understanding large river function in the GCPO, where these systems dominate the landscape.

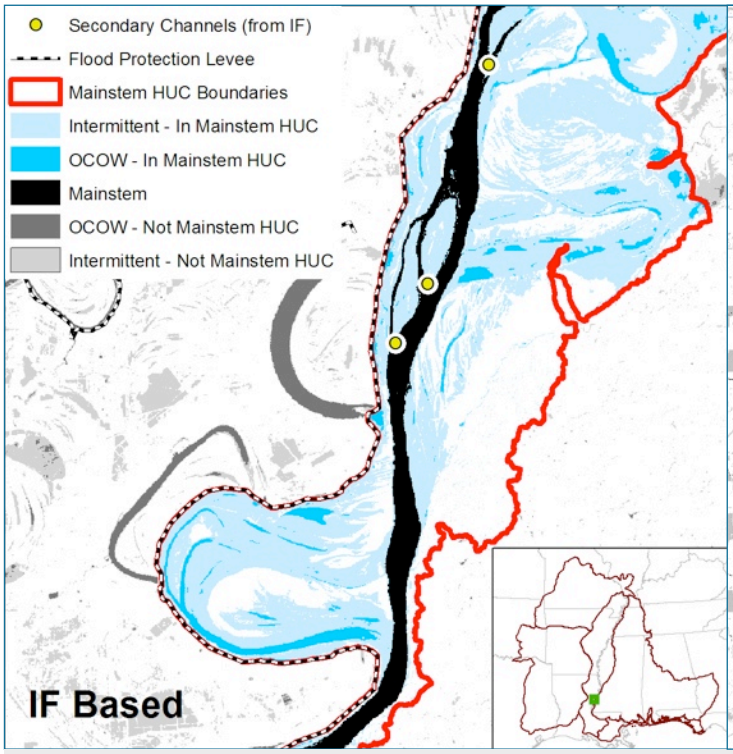

Figure 2. Example of the habitat features evaluated in this assessment. "OCOW" refers to "off channel open water" - persistently inundated areas not directly associated with the mainstem river.

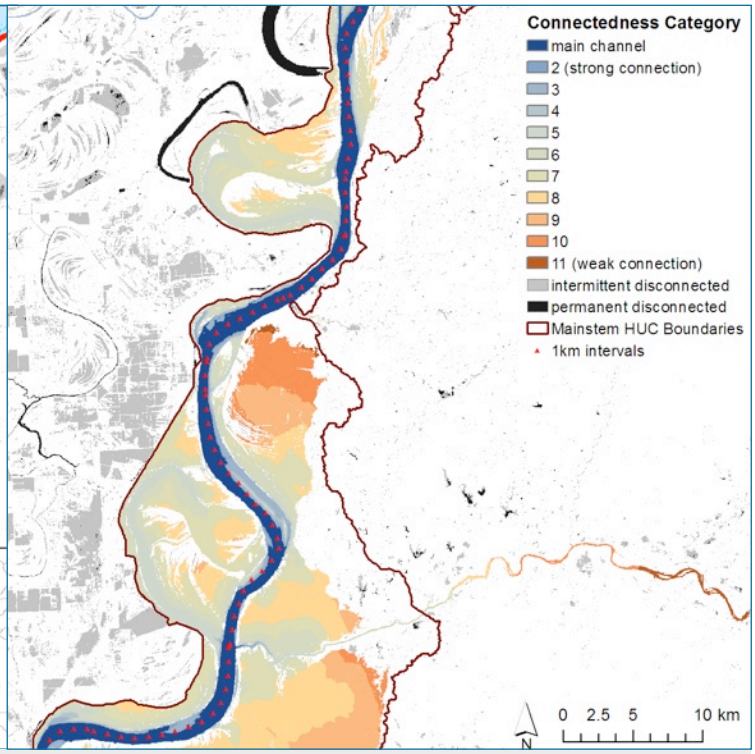

Figure 3. Example of mainstem big rivers connectedness analysis for the lower Mississippi River near the St. Catherine Creek National Wildlife Refuge. Blue indicates strong connection.

AMOUNT

Maintain current river miles

There are a total of 3,444 km of mainstem big rivers within the MAV (32% of mainstem big river length for the GCPO) (See Fig. 1). Eight of the rivers that are encompassed within the GCPO have their headwaters in other LCCs. These include the Tennessee, Ohio, Upper Mississippi, Missouri, Trinity, Black Warrior, Alabama, and Flint rivers. The course of several mainstem big rivers –the Neosho, Osage, Missouri and Tennessee – transit in and out of the GCPO. U.S. rivers have generally undergone extensive channel alterations for purposes of navigation, making the maintenance of current river miles an important goal.

CONFIGURATION

Maintain linear connectedness

The presence of dams along mainstem big rivers impacts ecosystem function by forming a physical barrier to movement and dispersal; altering the natural flow regime with respect to timing, magnitude, and rate of change; altering sediment dispersal and depth. The absence of dams may be an indicator of natural flows. Within both the MAV and the GCPO the Arkansas River had the largest number of mainstem dams (15). All but one of the other big rivers in the MAV lack dams, but upstream inputs to all of these rivers have significant main channel dams.

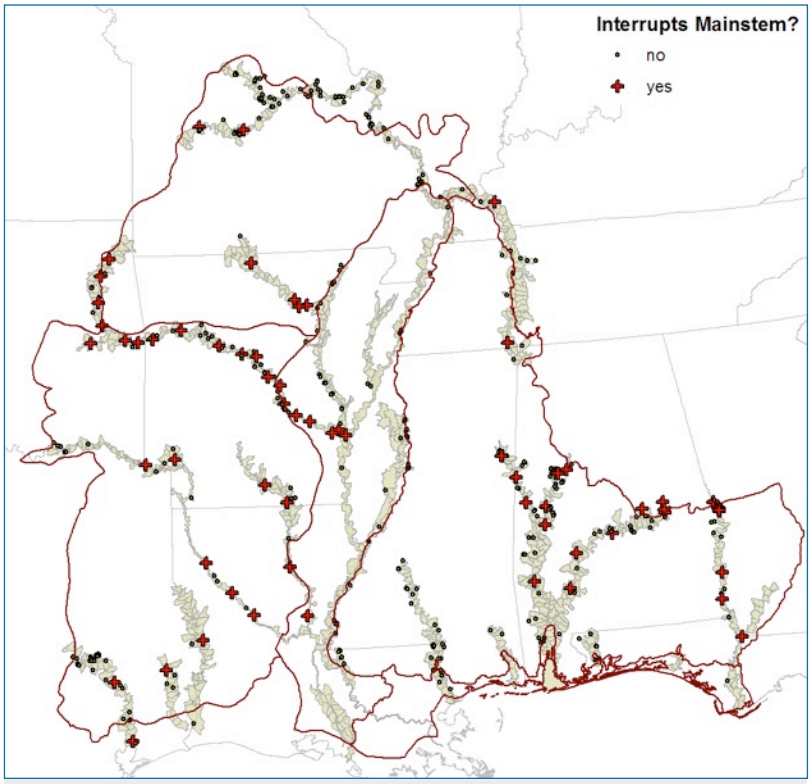

Figure 4. Location of dams along mainstem big rivers that interrupt/obstruct flow based on the 2012 National Anthropogenic Barriers Dataset (NABD), shown as red crosses. Other barriers within mainstem big river HUCs that do not obstruct mainstem flow are shown as dots.

Maintain a diversity of secondary channels

Secondary channels are separated from the main channel by sand bars, and they provide a diversity of habitats for a wide variety of organisms in large rivers.

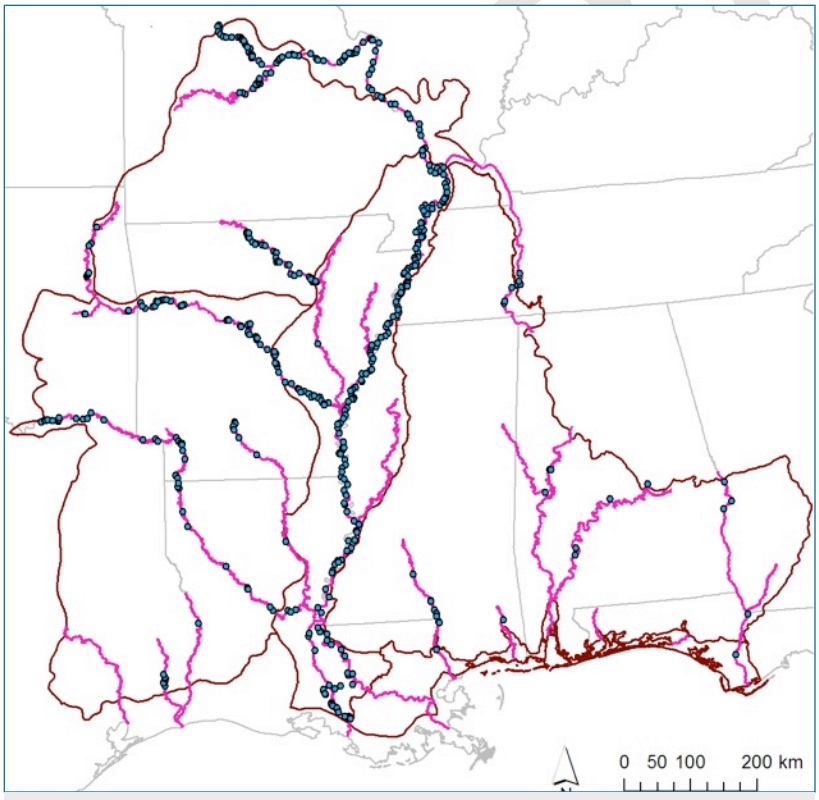

Figure 5. Distribution of secondary channels on mainstem big rivers within the GCPO based on analysis of inundation frequency.

A study by Killgore in 2012 provided a comprehensive analysis of the distribution and habitat quality of secondary channels within the lower Mississippi River, providing validation for the GCPO LCC's secondary channel assessment. The IF was used to identify the distribution and abundance of secondary channels in other mainstem big rivers of the GCPO.

The lower Mississippi River had the greatest number of secondary channels (143), but the highest density of channels occurred on the Missouri River (.147 secondary channels/km). The MAV has by far the highest percentage (46.9%) of secondary channels among GCPO mainstem big rivers, and those channels tend to be larger. Secondary channels were frequently found downstream of large dams.

Maintain a diversity of habitat types – deep water refugia on floodplain

Due to lack of bathymetric data, any open water body with >90% inundation frequency within the mainstem big river floodplain was included in this analysis, so this endpoint is referred to as “off-channel open water” or OCOW. Floodplain dependent aquatic species frequently take advantage of off channel deep water refugia, particularly within the GCPO where the timing and frequency of floodplain inundation is more predictable compared to similar areas in arid climates. These OCOW sites offer elevated productivity and moderate temperatures during winter. The highest area of OCOW tended to occur in floodplains within the MAV (61% of the total). Most other mainstem big rivers (including the Missouri and Tennessee) have relatively few OCOW sites within the GCPO; the mouths of rivers at the Gulf of Mexico had greater OCOW than their upper reaches.

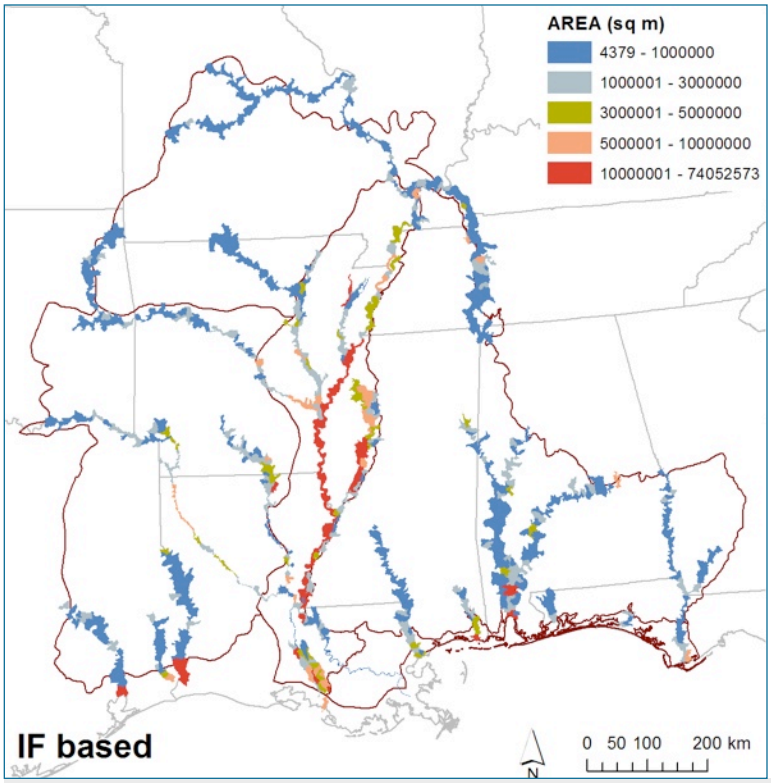

Figure 6. Area of off channel open water (OCOW) within the floodplain of mainstem big river systems within the GCPO, with reservoirs excluded.

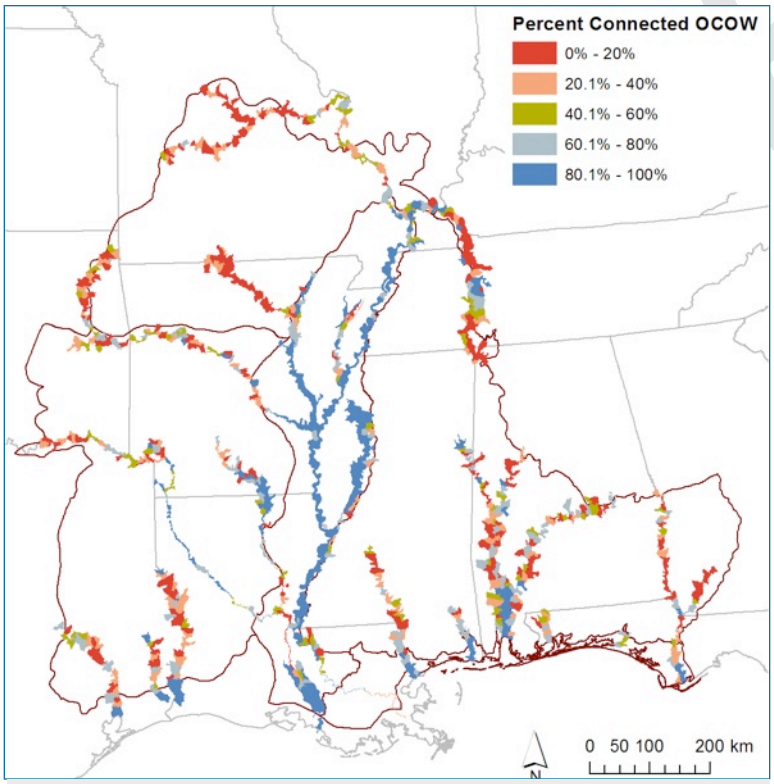

Figure 7. The percent total area of off channel open water (OCOW) that is connected to mainstem big rivers within the GCPO.

Maintain connectivity among a diversity of habitat types – deep water refugia on floodplain

This Assessment uses the connectivity data layer described on p. 2 to evaluate the degree of connectedness for each area of OCOW with the main channel. Major physical changes in floodplain lakes are linked to reduced connectivity, including loss of depth and area – both factors that impact the longevity of the lake. An intermediate level of connectivity may be most conducive to the development of lacustrine fish communities and long term stability of the lake.

The highest degree of connectivity to the floodplain occurs in OCOW areas of the Gulf Coast (92%) and the MAV (80%). However, other subgeographies all report lower areas of connected OCOW (61% to 54%). Much of the MAV falls within the moderate range of connectivity.

Maintain a diversity of habitat types – intermittently inundated floodplain

The floodplain is an integral part of large river ecosystems, and the timing, extent, duration, and frequency of floodplain inundation greatly affects the quality of fish and wildlife habitat. Some aquatic species rely on floodplains for spawning, moderate temperatures, and refugia from predation; people rely on them for ecosystem services such as flood mitigation. The total area of intermittent inundation (inundation frequency of 10-90%) is greatest in the MAV (8,311 km^2 or 60% of the total). At a minimum, large river floodplains should not be reduced, and because many have been converted to agricultural production, conservation should ideally focus on increasing available floodplain where practicable.

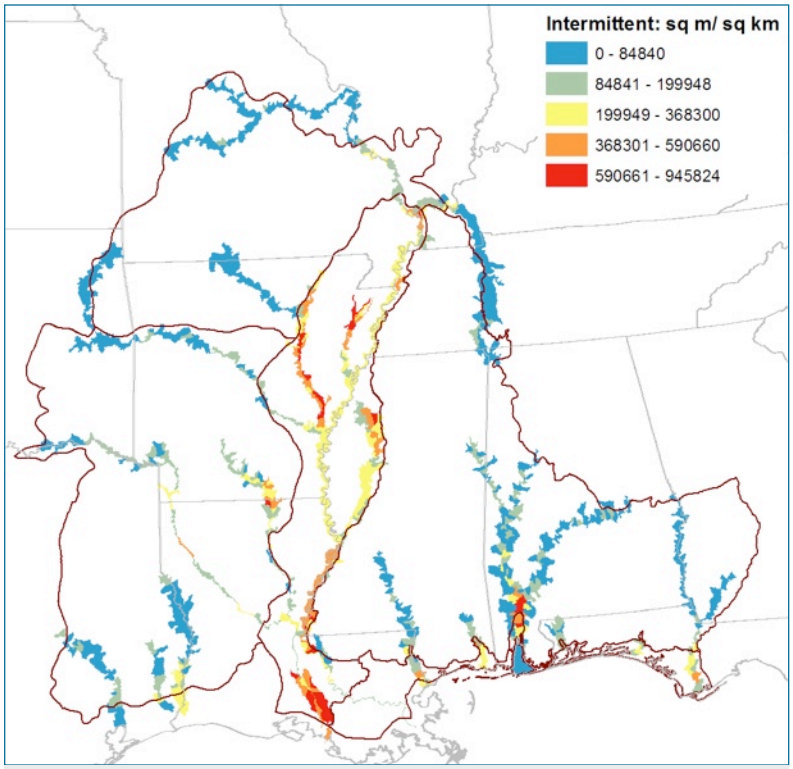

Figure 8. Amount of intermittent inundation (10-90%) normalized by the total area for mainstem big river HUCs.

Maintain connectivity among a diversity of habitat types – intermittently inundated floodplain

This analysis quantifies not only the amount of intermittent inundation on mainstem big river floodplains within the GCPO, but also provides a measure of habitat availability and accessibility from the rivers. These results also indicate that connected-ness categories may be a good surrogate for estimates of thermal conditions on large river floodplains. The MAV has the greatest percentage (80%) of floodplain connected to mainstem big rivers of the GCPO, with a moderate degree of connectivity. Low connectivity values (see Fig. 9) mean a strong connection with the river, whereas high values mean a weak connection often located far offstream. With the exception of the upper Ouachita and Mobile Rivers, the small areas of intermittent inundation along the big river floodplains of the East and West Gulf Coastal Plains tend to be highly connected with the adjacent river.

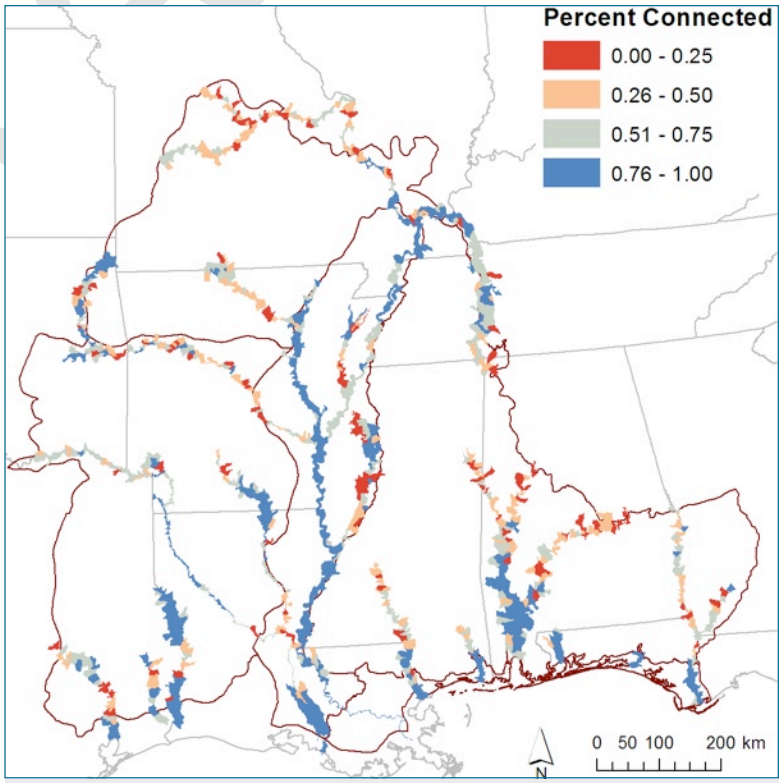

Figure 9. The percent total area of intermittent inundation that is connected to mainstem big rivers within the GCPO.

Maintain a diversity of habitat types – Vegetation on intermittently inundated floodplain

Vegetation on intermittently inundated floodplain plays an important role in the life cycles of both aquatic and terrestrial species. This analysis characterized these areas as either forested or low open vegetation. Forest is the predominant landcover type subject to intermittent inundation on mainstem big river floodplains throughout the GCPO (70%), and 89% of that is woody wetlands. The MAV has the highest area of intermittent inundation (4,903 km^2), with 65% of that area forested and 33% with low open vegetation. (No map shown).

Maintain a diversity of habitat types – Sandbars

Sandbars have sparse, intermittent, or no herbaceous plant cover and lack woody vegetation, as distinguished from islands. They are important for use by birds, turtles, and spawning riverine fishes. The highest area of sand bars occurs along the lower Mississippi River corridor as well as the upper reaches of the Red River, primarily in Arkansas. The MAV has the highest area of sandbars in the GCPO (59 km^2 or 50% of the total).

Maintain a diversity of habitat types – Natural sinuosity

High sinuosity as a measure of increased habitat diversity is important because large rivers are frequently straightened to reduce localized flooding and increase navigability. Following accepted practice, sinuosity was measured over reaches that are 20-30 times channel width. Mainstem big river reaches were classified into three sinuosity categories: good, intermediate, and poor. In the MAV, 66% of the mainstem big river segments show good sinuosity. The Tallahatchie, Yazoo, and Atchafalaya Rivers tend to have low sinuosity. The White River generally has high sinuosity; most of the mainstem Mississippi River has intermediate sinuosity.

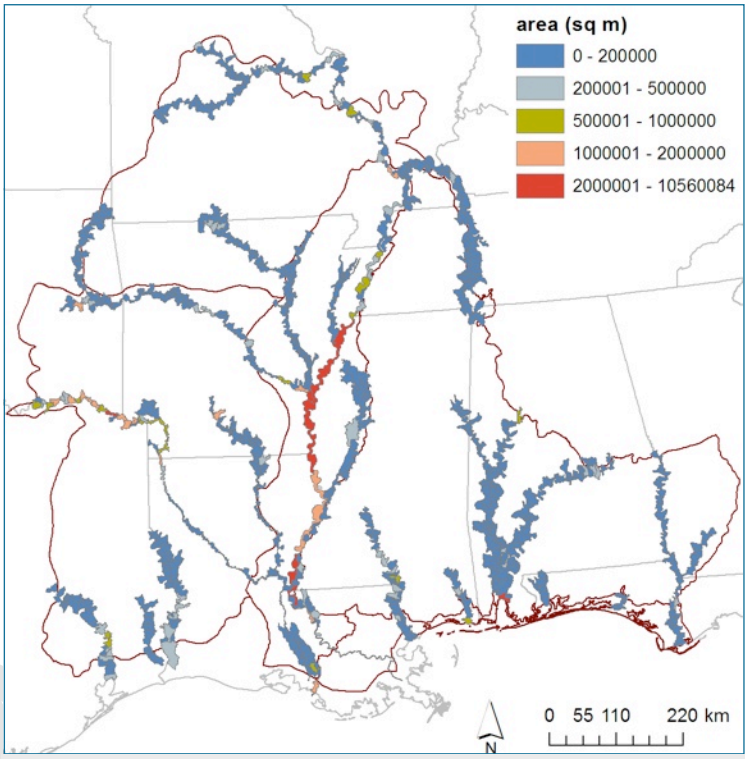

Figure 10. Area of sand bars within the floodplain of mainstem big river systems of the GCPO.

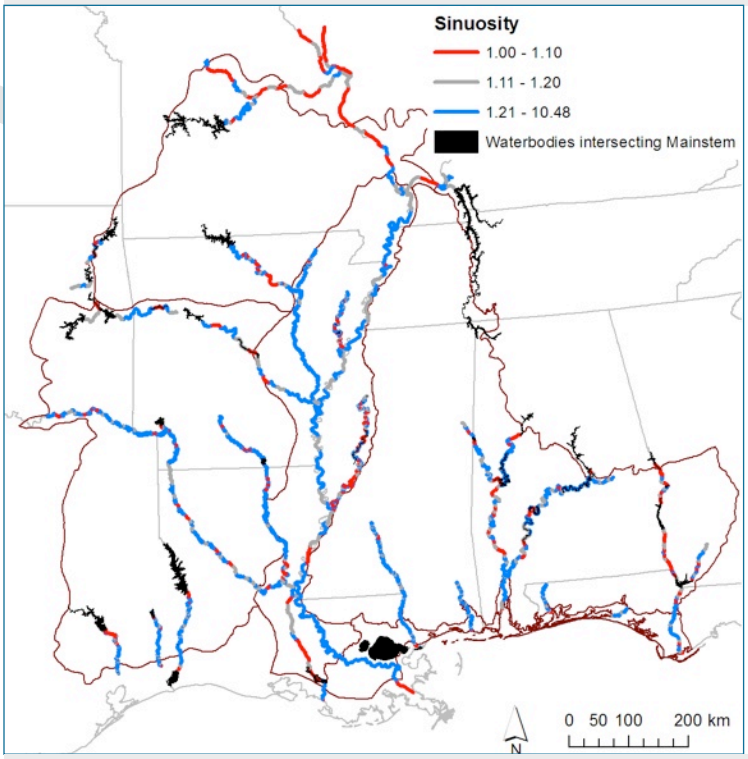

Figure 11. Distribution of sinuosity for mainstem big rivers within the GCPO. Blue lines show segments with good sinuosity; red lines show poor sinuosity.

CONDITION

Water quality and quantity - not assessed

In this assessment the following metrics were not explicitly addressed: Dissolved oxygen (DO), temperature, and main channel flow volumes. DO levels are typically adequate in the mainstem of large river systems, although oxygen levels can become critical in summer months near the bottom and within impoundments. Off channel open waters are subject to low DO in summer, but oxygen levels and temperature may be directly related to connectivity with the main channel. Information on adequate seasonal high and low flows is also not presented, but data on dams and the degree of interaction with the floodplain are (with potential to impair or indicate adequate flows, respectively).

Opportunities for Management

Because the floodplain is such an important component of large river systems, and many large river floodplains have been converted to agricultural production, conservation action should ideally focus on increasing available floodplain where practicable. At the location of a recent successful floodplain restoration project, the IF dataset showed a high frequency of inundation even before work began. The IF dataset may therefore be highly useful in identifying areas that provide marginal returns for agriculture but hold great potential to provide important ecosystem services if reconnected to a mainstem big river system. In addition, the new quantitative analysis of floodplain connectivity (see p. 2) may be used to set conservation targets for connectivity throughout the GCPO, which could be incorporated as more explicit landscape endpoints into future versions of the ISA. For example, habitat adjacent to mainstem big rivers that is currently disconnected but frequently inundated may offer potential for conservation action.

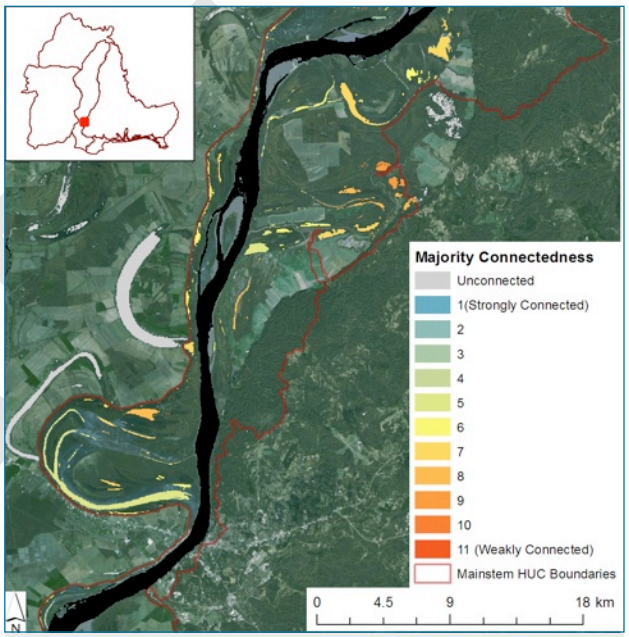

Figure 12. Example of connectedness assessment for off channel open water described in the text. Black shows the Mississippi River.

Opportunities for Improving Data

- ★ This Assessment suggests thresholds to describe big river habitats in good condition at a landscape scale, but they need to be further validated against reference data to improve reliability.
- ★ The lack of updates to NHD data will limit future detection of changes in mainstem channels.
- ★ In the NABD, the inventory of smaller dams or weirs is questionable.
- ★ The current analysis of secondary channels only describes channel location but does not describe condition (e.g. flow velocity/variability), volumetric data, or adjacent landcover contributions.
- ★ The IF will not accurately capture inundated locations that also have dense, understory vegetation that persists throughout December through March. Also, a detailed analysis based on long-term gaging data would be required to reveal whether the IF dataset has captured the full range of inundation conditions for an individual local watershed.
- ★ Future monitoring of secondary channel locations and condition may be possible using satellite imagery acquired under low water conditions in the fall.