DRAFT **Gulf Coast (GC) Estuarine Tidal Marsh**

From the Executive Summary

of the 2016 State of the GCPO

GCPO

Gulf Coastal Plains & Ozarks

Landscape Conservation Cooperative

DRAFT SUMMARY

PHOTOS, CITATION, ACKNOWLEDGEMENTS

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Tidal River in Grand Bay National Wildlife Refuge - U.S. Fish and Wildlife Service

p. 6: Apparent propeller scarring effects in St. Joseph Bay, Florida SAV beds - ESRI World Imagery; Hawke's Marsh at Grand Bay NERR - Gretchen L. Grammer, NOAA

Recommended citation:

Gulf Coastal Plains & Ozarks Landscape Conservation Cooperative. 2016. State of the Gulf Coastal Plains and Ozarks Tidal Marsh Assessment-in-Brief. 9 pages.

Produced by the Gulf Coastal Plains & Ozarks Landscape Conservation Cooperative, with the assistance of numerous partners including the following reviewers:

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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. 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. Several multi-agency consortiums, including the Gulf Coast Ecosystem Restoration Task Force, have identified conservation and restoration of coastal wetland ecosystems and protection of coastal estuaries as a top priority for conservation in the Gulf region.

The GCPO LCC identified estuarine tidal marsh as one of two initial priority ecological systems of focus along the Gulf Coast in its Integrated Science Agenda (ISA). The ISA also identified priority species, which are hypothesized to be limited by ecological conditions of patch size, connectivity, emergent and submergent vegetative cover, edge, salinity, freshwater flow and other factors. The purpose of this Assessment is to understand both how much habitat is available and the current condition of that habitat relative to habitat targets, or endpoints, defined in the ISA.

To assess the ISA endpoints for estuarine systems, it was necessary that the most consistent, comprehensive, current and accurate data be used in summary and analysis. For the best possible assessment product we combined and cross-checked numerous geospatial datasets spanning variable time periods and data sources in the GCPO Gulf Coast geography, which spans portions of the Louisiana Deltaic plain eastward to the Apalachicola region of Florida.

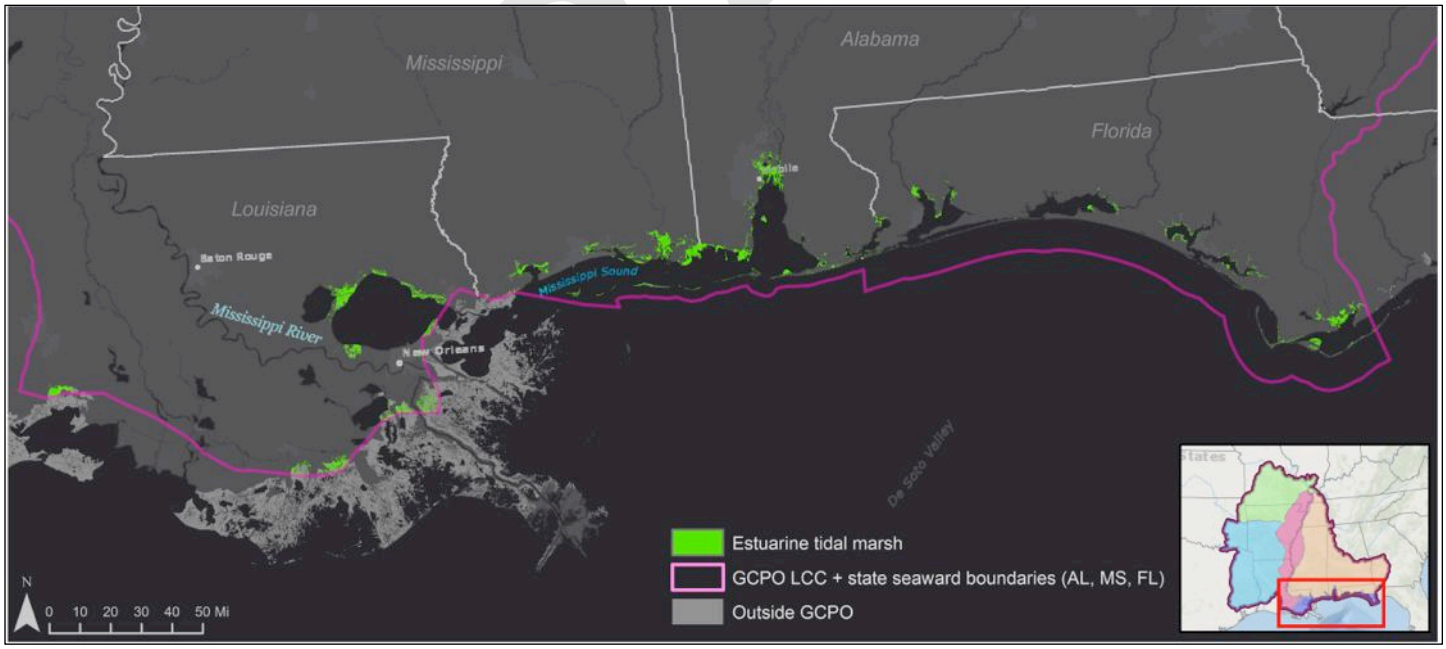

Figure 1. Estuarine tidal marsh along the GCPO LCC Gulf Coast (generated from USGS Marsh Type Delineation Project and Florida Cooperative Land Cover v3.1 data)

AMOUNT

Adequate acres to meet needs of tidal wetland wildlife at desired levels; no loss

The endpoint targeting adequate acreage to meet wildlife needs was left intentionally vague in the ISA because acreage needs will vary by species and estuarine system. However, a target of no further loss is clear because tidal marshes along the northern Gulf of Mexico have suffered tremendous losses over the past half century. Losses of tidal marsh to open water through wave effects, storm events, subsidence, sea level rise, and changes in salinity are among the primary causes of estuarine marsh declines in the northern Gulf of Mexico. Limited losses may be expected in these dynamic systems, as long as natural processes to offset these losses are maintained over time. Using data provided by the U.S. Geological Survey and state of Florida we estimate 202,584 acres of estuarine tidal marsh is present along the GCPO LCC Gulf Coast geography, with 37% of acreage found in GCPO portions of Louisiana. Of this, an estimated 103,538 acres (51%) of estuarine tidal marsh in the GCPO are permanently protected, with 87%, 59%, 40%, and 30% estimated protected in the Mississippi, Florida, Alabama, and Louisiana portions, respectively. We also estimate a net loss of 15,116 acres of estuarine wetland from 1996 to 2010 using a separate dataset generated by the NOAA Coastal Change Analysis Program: 78% of losses were to open water, much of it in the Mississippi River delta marshes east of the river, but 1,326 acres (9%) were also lost to development.

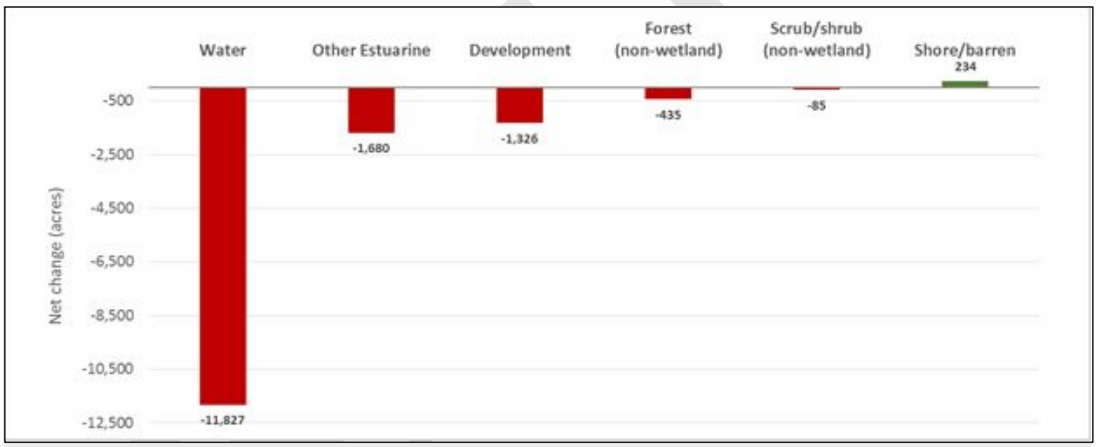

Figure 2. Net change in estuarine emergent and shrub-scrub wetland classes to other land cover categories along the GCPO Gulf Coast 1996-2010 (based from NOAA Coastal Change Analysis Program data)

CONDITION AND CONFIGURATION

Large blocks of unbroken marsh (>250 ac)
Structure: Emergent vegetative cover >70% / open water cover <20%

Though the needs of species vary, the integrity of Gulf Coast tidal marsh systems requires at least some marsh cover be available in large blocks of unbroken vegetative cover to protect them against fragmentation, to meet home range requirements for certain marsh-dependent species. To effectively assess the endpoint targeting large blocks of unbroken marsh we combined two interdependent endpoints of emergent vegetative and open water cover to delineate the third endpoint quantifying "unbroken" area. Of the 35,097 estuarine tidal marsh blocks intersecting the GCPO Gulf Coast we found144 blocks of marsh >250 ac in size. We estimate 142 of those can be considered unbroken(>70% emergent vegetative and <20% open water cover). We found 73% of marsh acreage is located within large patches >250 ac intersecting the GCPO portion of the Gulf Coast, suggesting a relatively small number of large patches hold a disproportionate amount of unbroken tidal marsh acreage. Two of the three largest unbroken marsh blocks (over 28,000 ac combined) intersecting the

GCPO geography were found north of Vermillion Bay in Iberia Parish, LA (near Avery Island), whereas the second largest block was found in and around the Grand Bay National Wildlife Refuge/ National Estuarine Research Reserve in MS/AL.

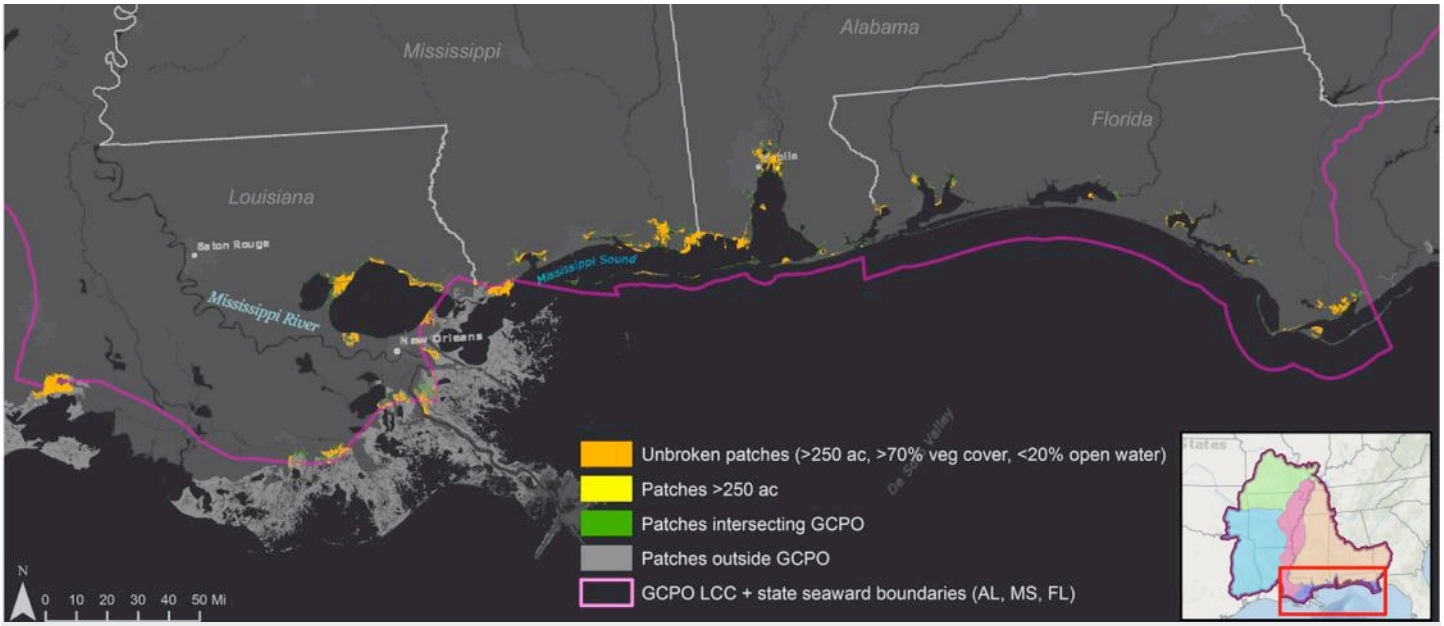

Figure 3. Large "unbroken" (orange) patches of estuarine tidal marsh >250 ac in size along the GCPO Gulf Coast.

CONFIGURATION

Connectivity of habitat types reflective of interdigitation of marsh types

The interplay of rivers and the sea, combined with elevation, salinity, tidal inundation, and other features, all contribute to the distinct zonation and interdigitation (interlocking configuration) of plant life in estuarine tidal systems. This zonation in turn contributes to animal diversity; it manifests as a gradient from low salt marsh to high tidal freshwater marsh, with some brackish, middle marsh (mesohaline/medium salt), and intermediate (oligohaline or low salt) marsh. Estuarine marsh was fairly well-mixed across all patches in Louisiana, Mississippi, and Alabama (data for Florida unavailable), with patches composed of 27% saline, 40% brackish, and 31% intermediate marsh over the three states. Marshes within the Louisiana Deltaic Plain are much different in composition, with far greater brackish and intermediate marsh and and minimal saline marsh in the estuaries influenced by the Mississippi River. Data suggest that most large patches were sufficiently interdigitated, though degree of interdigitation varied widely by marsh patch.

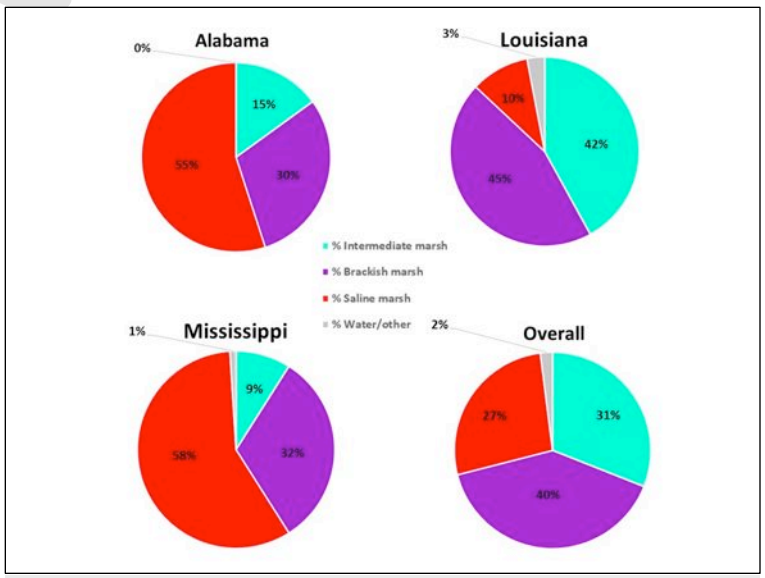

Figure 4. Figure 4. Mean composition of saline, brackish, intermediate, fresh, water and other classes in estuarine tidal marsh patches in AL, LA, and MS portions of the GCPO.

Moderate amounts of edge within large blocks of marsh

Habitat edges are areas where land cover types change abruptly; some species respond positively to edge, while others respond negatively. Evidence also suggests marsh-open water edge is an important seasonal feature for many fish species using estuaries as nurseries, likely due to a relative abundance of prey species. This edge assessment did not consider edge between different marsh types, only edge with open water and different landscape classes; total edge for each patch includes patch boundaries. This ISA endpoint suggests moderate amounts of edge in large blocks of marsh would suffice to holistically meet the needs of identified priority species. Total edge and edge density measures varied widely in large patches (>250 ac) vs. small patches (<250 ac), with areas of low edge density in the large patches of intact marsh along coastal Alabama and Mississippi, western Lake Pontchartrain, and west of the Mississippi River in Louisiana.

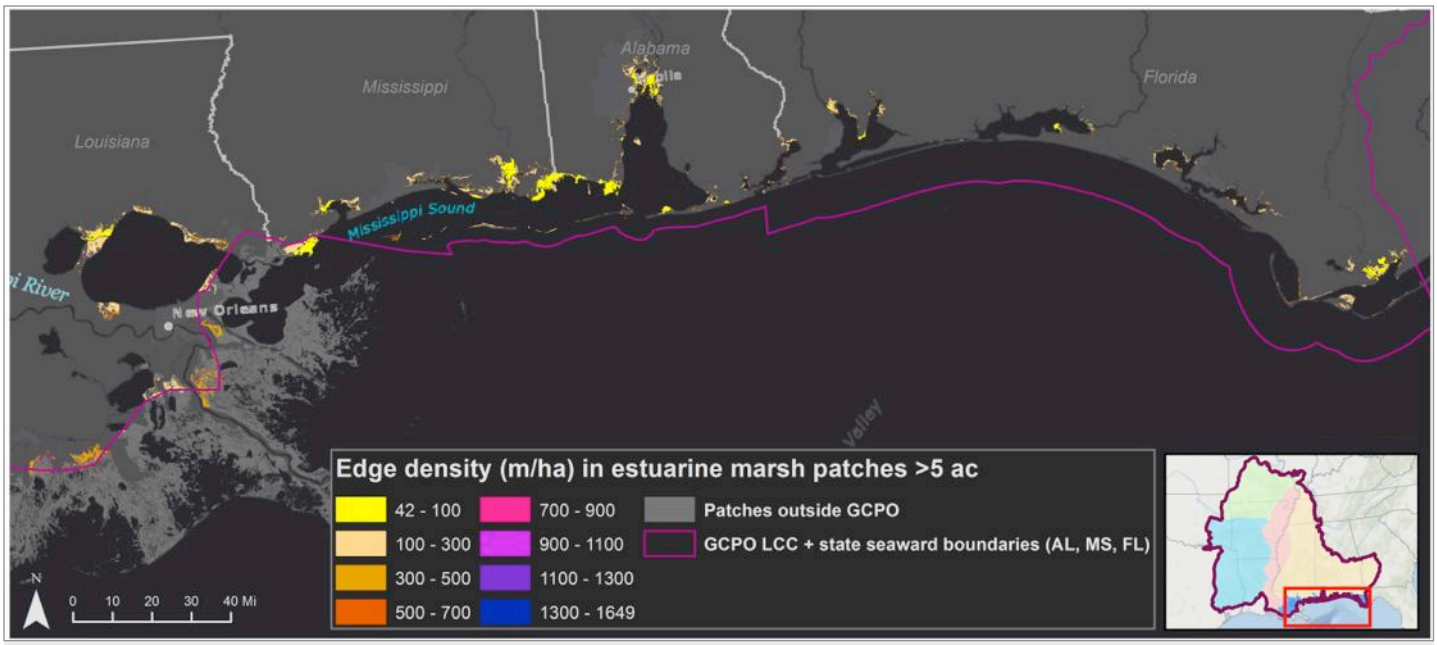

Figure 5. Edge density (m/ha) in estuarine tidal marsh patches >5 ac in size along the GCPO LCC Gulf Coast subgeography.

Presence of barrier islands in riverine-dominated systems

Barrier islands compose more than two-thirds of the U.S. Gulf of Mexico coastline, and they help to mitigate storm surge and flooding events while providing critical habitat for breeding and migratory wildlife, often within island-associated marsh complexes. Barrier islands are dynamic systems that typically lose area over time. Major storm events over the last half century have reduced the protective features that barrier islands provide to estuarine marsh systems and coastal communities. To address this endpoint, the Assessment measures presence of barrier islands, length of protected coastline, and hurricane frequency and severity to estimate the proportion of GCPO coastline potentially protected by the presence of a barrier island. The results suggest there are 16 barrier islands totaling 44,860 acres within the Gulf Coast portion of the GCPO region, most of which (69%) are <2% developed and are also under protected public ownership. Also, 50% of the 1,500 miles of coastline within the GCPO is protected by barrier islands coverage, but 92 hurricanes have impacted that same GCPO coastline (MS, LA, FL panhandle) from 1851 – 2004, with the 2004 and 2005 seasons ranked by NOAA as two of the top four activity seasons in the last half century.

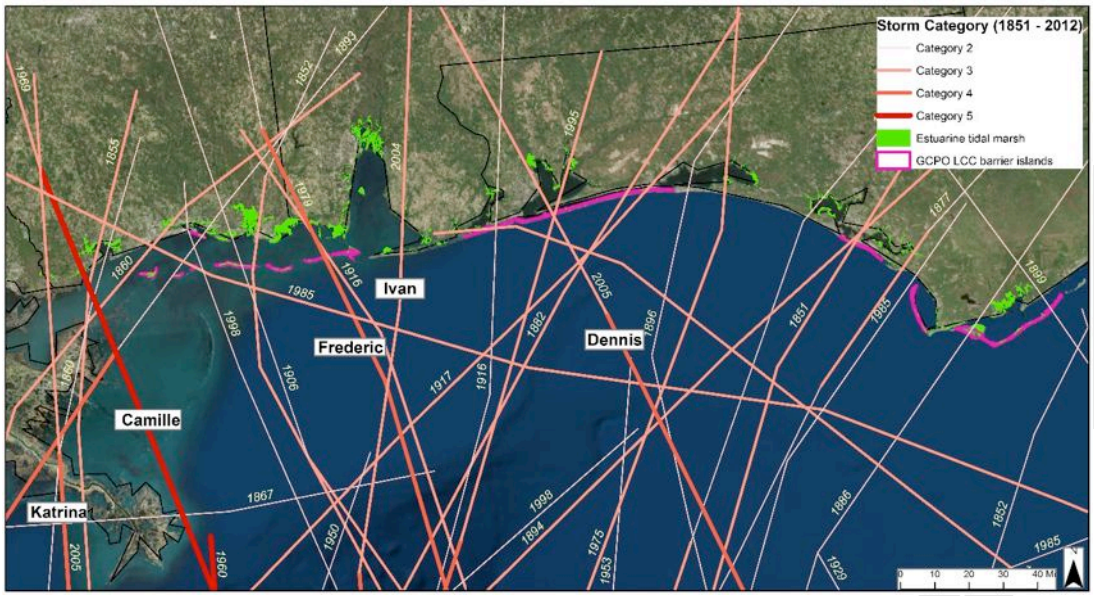

Figure 6. Category 2-5 tropical storm/hurricane tracks in the GCPO portion of the northern Gulf of Mexico from 1851 to 2012.

CONDITION

Structure: Submergent vegetative cover 15 – 30%

Seagrasses and other species of submerged aquatic vegetation (SAV) provide complex ecological and economic functions, including sediment stabilization, nutrient cycling, water quality improvement, coastal protection, and nursery/shelter habitat for both commercial fishery species and many species of concern. However, seagrasses in particular are showing a net decline in the northern Gulf of Mexico from threats such as impaired water quality/clarity, physical removal, and propeller scarring. The highly dynamic nature of SAV populations and distributions make it difficult to delineate a static distribution map. A combined analysis of four datasets (covering 1940-2015) yields an estimate of 34,501 acres of SAV in the GCPO Gulf Coast, with 84% found in the western Florida panhandle.

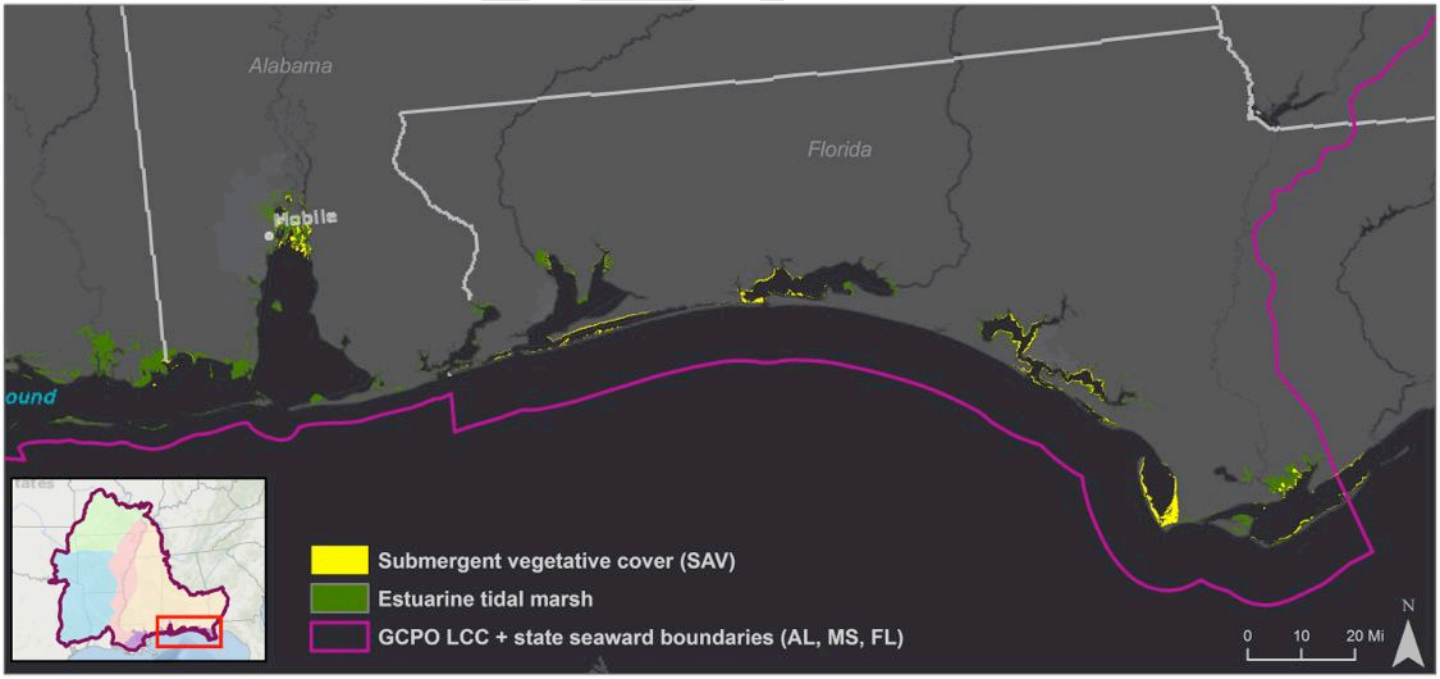

Figure 7. Mapped submergent vegetative cover (SAV) (yellow) along the GCPO LCC Gulf Coast in comparison to estuarine tidal marsh (green).

In assessing estuarine marsh-SAV proximity, one large patch (>250 acres) exhibited SAV coverage of 15-30% in open water pockets within the patch, suggesting limited presence of SAV in relation to tidal marsh patches; however, the pictures improves somewhat when including SAV patches within 300 to 500 m of tidal marsh patches.

Apparent propeller scarring effects in St. Joseph Bay, Florida SAV beds (Source: ESRI World Imagery).

Composition: Dominated by native plants typical of high, mid-, intermediate, and low marsh

Plant species have different tolerances to salinity gradients, resulting in a diversity of plant species across high, middle, intermediate, and low marsh. However, saline estuary species typically exhibit lower plant species diversity than tidal freshwater marsh. In the GCPO, eastern vs. western coastal plain salinity and vegetative composition vary as a result of influence vs. non-influence of the Mississippi River. Datasets were combined to assess county- and parish-level distribution of a subset of four native graminoid (i.e. grass) tidal marsh species: *Juncus roemerianus*, which typically dominates brackish/intermediate marsh; *Spartina alterniflora*, *Spartina patens*, and *Distichlis spicata*, all of which tend to occur at the seawater-marsh edge; as well as a comparative assessment of the native invasive *Phragmites australis*, which is widespread. The Assessment indicates that *Spartina alterniflora* and *Distichlis spicata* are known to be distributed in 16, and *Juncus roemerianus* is known to be distributed in 18 of the 35 counties and parishes that intersect the Gulf Coast subgeography of the GCPO LCC. *Spartina patens* is present in all those Gulf Coast counties and parishes.

Hawke's Marsh at Grand Bay National Estuarine Research Reserve clearly shows zonation of marsh species associated with changes in topography and salinity.

Water quality and quantity: Salinity and freshwater inflow aligned along a natural gradient

The interplay between freshwater availability, range of tidal influence, and marsh salinity is fundamental to maintaining estuarine ecological function, and it influences vegetation composition and structure of coastal marsh systems. Disruptions in freshwater flow caused by changing climate, diversions, channelization, levees, and direct consumptive withdrawals, have impacted quantity, quality, and periodicity of freshwater flow, and can disrupt natural salinity gradients in addition to causing changes in sediment transport and nutrient delivery to coastal estuaries. Marsh salinity in the northern Gulf of Mexico is highly influenced by freshwater inflows from the Mississippi River, particularly in the Louisiana Deltaic Plain. Other peak flow watersheds in the GCPO include Grand Bay and Mobile Bay in Alabama, the Upper West Pascagoula in Mississippi, the East River-Apalachicola in Florida, and the Pearlington-Pearl in Mississippi. Assessments of flow seasonality in coastal estuaries found most rivers in the GCPO region of the western Florida panhandle are seasonally steady, whereas areas approaching the Mississippi River in Louisiana saw a shift to high seasonal variability (high season February to March and low season August to October).

Salinity in estuaries impacted by these watersheds is also variable depending on season, year, tide, freshwater pulses, wind, mixing levels and geographic location. This Assessment compiled 1,464 stations within the GCPO geography with ongoing (hourly, daily, yearly) or point estimate salinity measures to assess and compare salinity gradients for high and low salinity seasons across estuaries (transitional seasons were not assessed). Data from NOAA suggest "natural" salinity gradients were evident in most of the major riverine estuary systems in the late 1990s, with those in the western Florida panhandle typically subject to greater near-shore and in-bay salinity levels than their western counterparts. Dams and impoundments were found in upper reaches of estuarine rivers and streams, with few dams within the estuaries themselves. Analysis of tidal influences suggests tide ranges are limited to <1 m across the GCPO with some areas approaching zero tidal range. In short, estuaries within the GCPO region's Gulf Coast geography exhibit a broad spectrum of interactions among freshwater flow, tidal range, and salinity. In the absence of clear targets reflecting natural salinity gradients, adequate flows, and tidal influence, these data were not incorporated into the compounding assessment of estuarine patches (highlighting patches that meet most or all end point criteria).

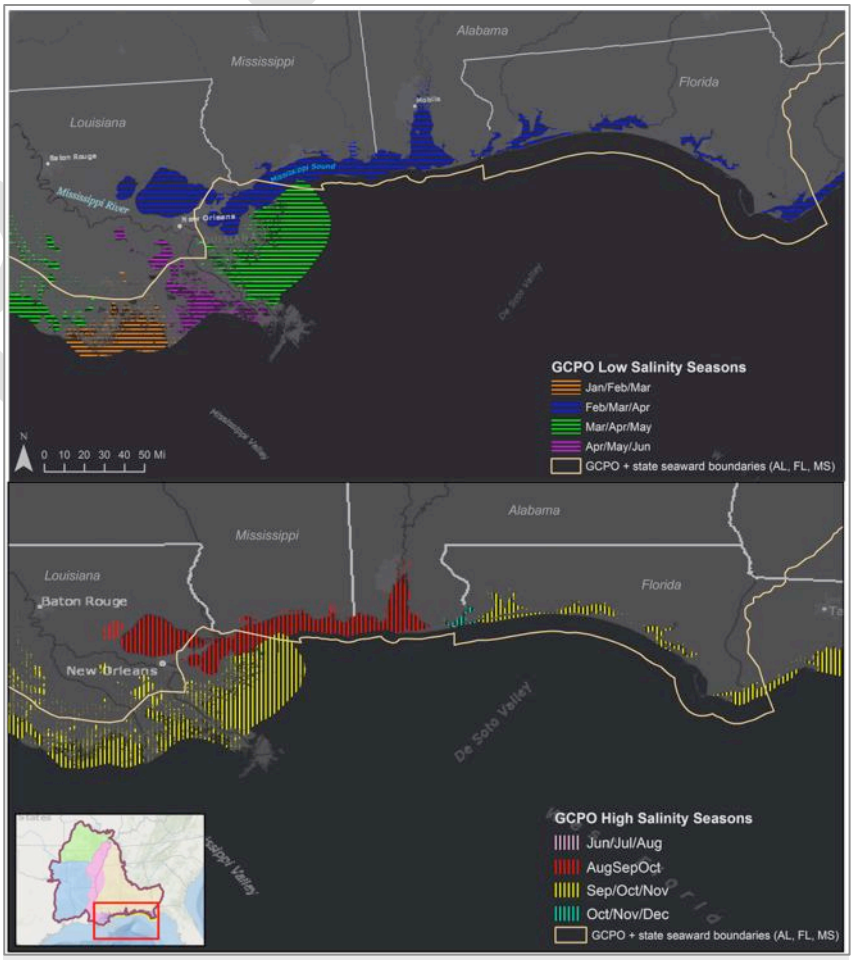

Figure 8. NOAA low and high salinity seasons within the GCPO LCC and bordering LCC geographies along the Northern Gulf of Mexico.

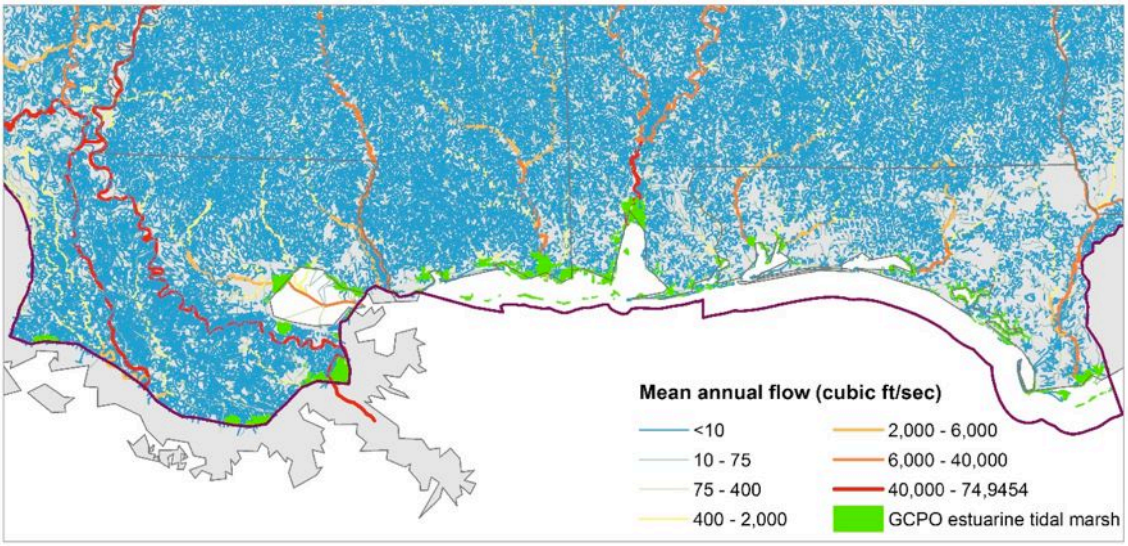

Figure 9. Measures of mean annual flow (ft^3/sec) for the Gulf Coast portion of the GCPO LCC geography

Conclusion: Assessing Desired Ecological State for Gulf Coast Estuarine Tidal Marsh

The final step in this Assessment was to combine endpoint criteria across all estuarine tidal marsh habitat into a condition index to understand how much and where tidal marsh within the GCPO region can be considered to be in a desired ecological state as specified in the ISA. ISA endpoint criteria included in the condition index analysis were patch size, emergent vegetative cover, open water, edge, connectivity/interdigitation of marsh types, and submergent vegetative cover. Excluded were measures of salinity, freshwater flow/tidal influence, and presence of barrier islands due to uncertainty in endpoint thresholds across estuaries; native vegetation was also excluded due to data limitations. This dichotomous, decision-based approach (see Figure 10) found that 67% of tidal marsh acreage was found in large unbroken patches and met an additional one or two landscape endpoints. within the GCPO Gulf Coast geography met six of the seven criteria. There were several other patches just outside of the GCPO boundary in Louisiana that also met these criteria. We estimate 32% of marsh acreage is found in unbroken patches that are <250 acres, suggesting significant opportunity to target marsh conservation and restoration efforts to strategically connect small unbroken patches to each other or to existing large patches.

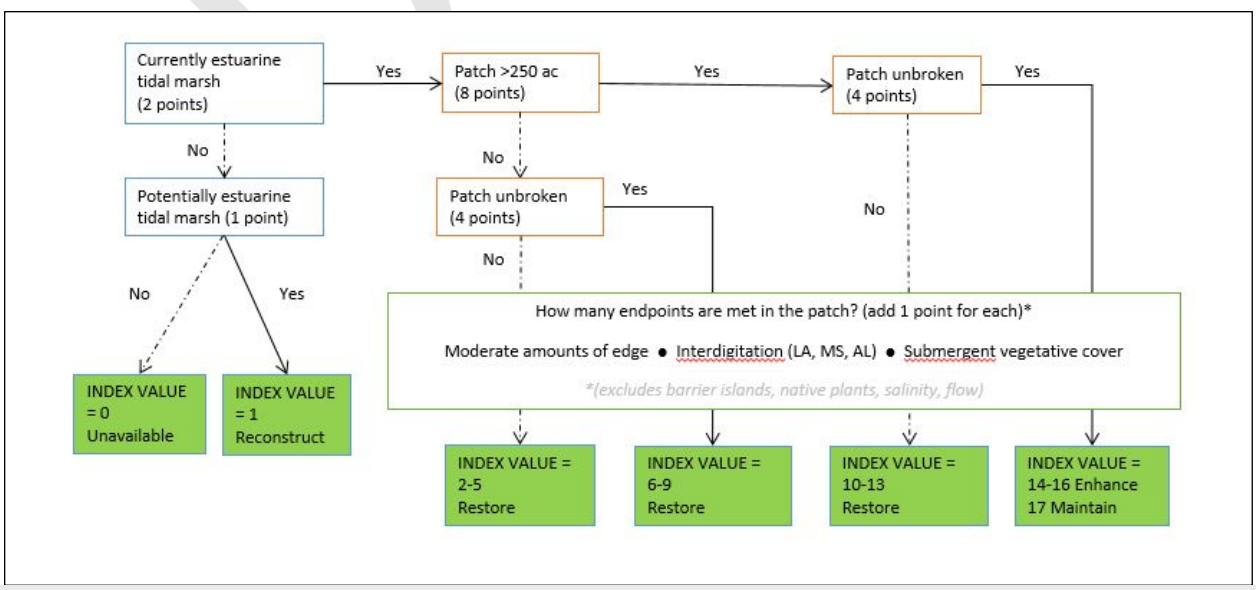

Figure 10. Dichotomous decision-based approach using landscape endpoints to assessing the configuration and condition of estuarine marsh patches along the GCPO LCC.

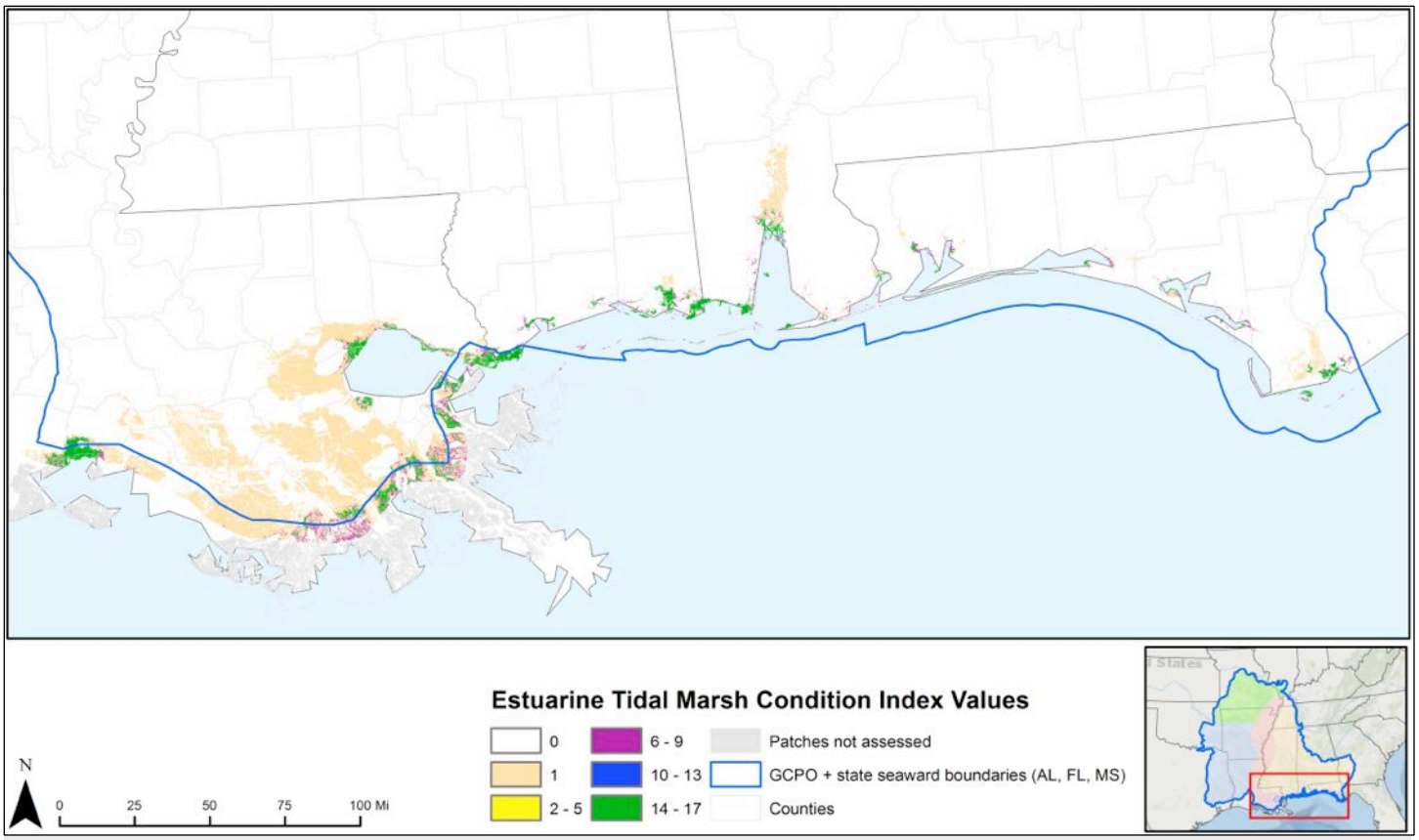

Figure 11. Condition index values based on decision-criteria for estuarine marsh patches ranging from a value of 1 indicating potential or future estuarine marsh to values of 14-16 indicating existing marsh patches meet most of the measurable endpoints and are approaching the desired ecological state.

This Assessment has highlighted numerous types of research needed to refine GCPO ISA-defined landscape endpoints mainly related to empirical relationships between priority species and estuarine habitat features. Examples of research and monitoring topics that are critical for improving understanding and informing how best to restore and manage these habitats include:

- patch dynamics (e.g., relationships with patch size and configuration) for priority wildlife species, including better understanding of geographic and temporal influences on patch dynamics;
- building linkages from freshwater inflow to estuarine condition and assisting marsh managers to apply this knowledge;
- relationships among species of interest and edges within the zonation of estuarine marsh types, including how edge effects vary with different land cover/vegetation type;
- maintaining and increasing the amount of permanent monitoring transects for seagrass in concert with standardized and long-term monitoring of water quality;
- expanded mapping of native marsh species zonation, plus mapping of invasive *P. australis* (NWI class E2EM5) under the National Wetlands Inventory program to produce a viable estimate of *P. australis* distribution throughout the Gulf Coast region.