Mississippi Sound

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Background

The Mississippi Sound is the primary body of water off the Mississippi Coast, extending from Lake Borgne, La. in the west to Mobile Bay, Ala. in the east and bordered by the barrier islands--Cat, Ship, Horn, Petit Bois, and Dauphin Islands--of Gulf Islands National Seashore to the south (Figure 1). It encompasses an estuary 293 km^2 (113 mi^2) large with a watershed of 259 km^2 (100 mi^2) and 44 km^2 (17 mi^2) of tidal marsh (Klein and others, b., 1998). It is approximately 129 km (80 mi) long, 3 m (10 ft) deep, and varies in width from 7.2 to 22.5 km (4.5 to 14 mi) (Klein and others, a., 1998). Average tidal range is 0.6 m (1.96 ft), with local water depth and surface level fluctuations largely affected by wind (Klein and others, b., 1998). The climate is semitropical/subtropical with south-southeast winds at approximately 10.4 kph (6.5 mph).

Major rivers draining into Mississippi Sound, including the Pearl, Pascagoula, and Alabama Rivers, tend to carry high sediment loads (Klein and others, b., 1998). Inland fresh water drainage from these and other smaller rivers, as well as St. Louis and Biloxi Bays, create an estuarine environment in the Sound. Variable salinity levels can affect the productivity and survival of organisms living in the Sound, as well as economic and recreational activities. Predominate vegetation includes *Juncus roemerianus* (black

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needlerush) and *Spartina alterniflora* (smooth cordgrass). Shrimp, crab, oysters, and multiple species of finfish can be found in the waters of the Mississippi Sound.

Methodology Employed to Determine and Document Current Status

Natural color, 1:24,000-scale aerial photography was acquired. The mapping protocol consisted of stereoscopic photointerpretation, cartographic transfer, and digitization in accordance with strict mapping standards and conventions. Other important aspects of the protocol included the use of the Cowardin Classification System (Cowardin et al., 1979), groundtruthing, quality control, and peer review. Land, water, and areas where emergent wetlands were present were included on the maps.

The information derived from the photography was subsequently transferred using a zoom transfer scope onto a stable medium overlaying U.S. Geological Survey (USGS) 1:24,000-scale quadrangle basemaps. The primary data sources were 1:24,000-scale natural color aerial photography flown by National Aeronautics and Space Administration (NASA). In those cases where the data were inadequate or incomplete, contemporary supplemental data were acquired from other sources and used to complete the photographic coverage.

The groundtruthing phase included the participation of field staff from the USGS National Wetlands Research Center. Draft maps were sent to the agency and staff for review and comments. All comments received were incorporated into the final maps prepared and delivered.

Methodology Employed to Analyze Historical Trends

Historical emergent wetland trends were analyzed by comparing changes in total areal coverage of emergent wetland habitat along a time sequence. Comparisons were made among data sums of emergent wetland coverage for the 1950s, 1979, 1996, and 2008. Maps of emergent wetland distribution for these years were studied to determine the location of major changes of coverage. The 1950s data were derived from 1:20,000 scale, black and white aerial photography. The 1979 and 1996 data were derived from NASA 1:65,000 scale, color infrared aerial photography. The 2008 data were derived from NAIP 1-meter, natural color aerial photography.

Status and Trends

Emergent wetland monitoring during 1956, 1979/82, 1996, and 2007 (Figures 2-5) confirm the loss and decline of emergent wetland habitat in Mississippi Sound (Table 1). Mississippi Sound lost 13,745 hectares (33,964 acres), or 43.1%, of its emergent wetlands between 1979/82 and 1996 and an additional 3,653 hectares (9,025 acres), or 11.4%, of its emergent wetlands between 1996 and 2007. During the complete 29-yr time period, Mississippi Sound lost 17,398 hectares (42,989 acres), or 54.5%, of emergent wetland habitat. Only estuarine emergent wetland data was collected in 1956; consequently, 1956 is not included in palustrine or total emergent wetland calculations.

Table 1. Emergent wetland acreage in Mississippi Sound for 1956, 1979/82, 1996, and 2007.

Emergent Wetland Type	**1956**		**1979/82**		**1996**		**2007**		**Total Change 1979/82-2007 (1956-2007 for Estuarine only)**	
	Hectares	Acres	Hectares	Acres	Hectares	Acres	Hectares	Acres	Hectares	Acres

Estuarine	15,623	38,606	14,399	35,581	13,687	33,822	11,920	29,456	-3,703	-9,150
Palustrine	n/a	n/a	17,516	43,282	4,483	11,077	2,597	6,418	-14,919	-36,864
Total	n/a	n/a	31,915	78,863	18,170	44,899	14,517	35,874	-17,398	-42,989

Between 1956 and 1979/82, Mississippi Sound lost 1,224 hectares (3,025 acres), or 7.8%, of salt marsh. A loss of 712 hectares (1,759 acres), or 4.6%, of salt marsh occurred between 1979/82 and 1996, and another 1,767 hectares (4,367 acres), or 11.3%, of salt marsh were lost between 1996 and 2007. A total of 3,703 hectares (9,150 acres), or 23.7%, of salt marsh were lost during the entire 52-yr study period.

Mobile Bay lost 13,033 hectares (32,205 acres), or 74.4%, of coastal fresh marsh between 1979/82 and 1996. A loss of 1,886 hectares (4,659 acres), or 10.8%, in fresh marsh occurred between 1996 and 2007. A total of 14,919 hectares (36,864 acres), or 85.2%, of coastal fresh marsh were lost in Mobile Bay throughout the entire 29-yr study period.

Causes of Change

Shore erosion and marsh deterioration has caused land change and loss to the mainland marshes along the Mississippi Sound. The coast has lost nearly 1,619 hectares (4,000 acres) on the mainland to erosion since the mid-1850s; however, man has rebuilt over 809 hectares (2,000 acres) using dredge spoil disposal and other means, with the construction and reinforcement of hard structures such as seawalls and bulkheads to prevent further erosion (Klein and others, a., 1998). In addition to marsh shoreline erosion, a great deal of wetland loss that occurred prior to the 1973 Wetlands Protection Law in Mississippi was the result of filling and development of wetlands. Canalization has contributed to the conversion of marsh to open water; development and/or expansion

of marinas also account for some wetland loss. Suburbanization and residential development has contributed to much of the wetland loss from Waveland and Bay St. Louis to Pascagoula, and industrial development in the Pascagoula and Gulfport areas has contributed to habitat loss. Wetland loss around Biloxi and Gautier has been caused primarily by marsh deterioration and conversion to open water and development. Extensive development and dredge-and-fill operations along the lower Escatawpa River caused wetland loss between the 1950s and 1992. Although land subsidence on the Mississippi coast is minimal, predicted increases in the rate of relative sea level rise is another cause of concern for potential wetland loss. Pollution from agriculture, improperly treated sewage, roadways, accidental spills, industry discharges, and other sources also affect the health of the Mississippi Sound.

Monitoring for Emergent Wetland Health

Healthy emergent wetlands are some of the most biologically diverse habitats in North America, making these areas a high priority for conservation. The interdependence of coastal habitats necessitates holistic and ecosystem-based management. Monitoring for emergent wetland health in the Mississippi Sound is primarily associated with floral and faunal communities linked to the marsh ecosystem.

The Aquatic Invasive Species (AIS) Program of the MDMR aims to protect coastal Mississippi's waterways and marshes from the damaging effects of non-native plants and animals. The AIS field crew monitors over 2,414 km (1,500 miles) of waterways, regularly mapping areas of AIS. Quarterly aerial photo surveys provide efficient, regular monitoring of vast areas of difficult to access marsh areas. The program uses a coordinated approach of public outreach, education, monitoring and control.

Outreach and education materials serve to increase public awareness of established species such as Giant Salvinia (*Salvinia molesta*) and the reporting of new exotics such as Asian tiger shrimp (*Penaeus monodon*) and lionfish (*Pterois voltans*). All information gathered through the program is shared with the national Nonindigenous Aquatic Species Database, maintained by the U.S. Geological Survey.

The Grand Bay Estuarine Research Reserve (GBNERR) is part of the National Estuarine Research Reserve system and serves as a marine protected area and research facility in eastern Jackson County. The GBNERR has established monitoring efforts related to the health of emergent wetlands. Fifteen surface elevation table (SET) monitors have been installed along coastal transition transects to monitor elevation changes in four estuarine marsh habitats including salt pannes, *Spartina alterniflora*, *Juncus roemerianus*, and *Cladium jamaicense* marshes. In association with the 15 SETs, vegetation plots will be monitored as part of a larger effort to understand the effects of sea-level rise on coastal habitats. Associated ground water wells and water level loggers, along with detailed elevation information from DEMs (Digital Elevation Models) and surveyed-in SETs will provide a detailed look at accretion/subsidence processes, as well as vegetation response in relation to sea-level rise. The CORS (continuously operating reference station) project will provide real time position corrections for real-time kinematic GPS surveys, as well as provide subsidence velocities for the area.

The GBNERR's System-wide Monitoring Program (SWMP) is focused on water quality, nutrients, and meteorological data collection and monitoring. The program's long-term data collection efforts serve as a part of a nationally standardized network of reference sites, as well as sentinels for future change, and have facilitated a better

understanding of how basic environmental components affect estuarine habitats. Additionally, breeding marsh bird surveys are conducted annually to monitor population trends for this suite of marsh obligates. Eight emergent marsh complexes are surveyed three times annually during the breeding season, with approximately 200 locations sampled. Ancillary data collected with this monitoring include salinity, vegetation type and structure, tidal stage, and shoreline condition.

The Mississippi Department of Environmental Quality (MDEQ) routinely monitors water conditions within the Mississippi Sound and the surrounding bays and estuaries. Water quality parameters are grouped into five categories, and monitoring is conducted within water bodies of the Gulf Coast, including the Pearl River, Jourdan River, Wolf River, Bernard Bayou, Biloxi River, Back Bay Biloxi, Tchoutacabouffa River, Turkey Creek, Old Fort Bayou, Escatawpa River, and the Pascagoula River (MDEQ, 2008-2010). Additionally, the Mississippi Coastal Assessment samples 25 randomly selected sites at five targeted sites including Pearl River, Wolf River, the Biloxi and Tchoutacabouffa Rivers, Back Bay of Biloxi, and the Escatawpa and Pascagoula Rivers (MDEQ, 2009). Parameters measured include:

Physical-Chemical	Nutrients and Solids	Living Resources	Contaminants	Sediments
Dissolved Oxygen (mg L^{-1})	Dissolved Nitrogen (mg L^{-1})	Water Column Chlorophyll *a*	Inorganics (Metals) (mg/kg^{-1})	Total Organic Carbon (mg g^{-1})
Salinity (ppt)	Total Nitrogen (mg L^{-1})	Benthic Community Composition	PCB's (mg/kg^{-1})	Grain Size (%)
pH (standard units)	Dissolved Phosphorus (mg L^{-1})	Benthic Community Abundance	PAHs, Chlorinated Pesticides (mg/kg-1)	
Temperature (°C)	Total Phosphorus (mg L^{-1})	Submerged Aquatic Vegetation		
Water Depth (m)	Total Suspended Solids (mg L^{-1})	Macroalgae Abundance		
Secchi Depth (m)				

Mapping and Monitoring Needs

Methods for rapid classification of emergent wetland vegetation are needed to adequately monitor changes in structure and composition due to erosion, development, salinity shifts, and impacts from invasive species colonization. Of equal importance is

the improved monitoring of emergent wetland shorelines, shoreline erosion reduction and restoration, the inclusion of sea level rise information in the planning phases of restoration, and comprehensive land use planning.

Priority should also be given to maintaining records for emergent wetland enhancement, restoration, and creation projects. Only by monitoring these projects can we adapt future efforts to more effectively reach targets and increase probability of success. Also, establishing additional surface elevation tables coastwide could give greater detail into regional marsh surface changes.

Restoration and Enhancement Opportunities

Numerous programs have been established to benefit the emergent marsh ecosystems of Mississippi. For instance, 120 permit applications were authorized by the MDMR's regulatory division in 2011 for shoreline stabilization, totaling approximately 19,000 linear feet of shoreline impact. To reduce the cumulative impact, The MDMR's Bureau of Wetlands Permitting implements a three tiered permitting plan for shoreline stabilization stating, "Vegetation as a non-structural method shall be used in preference to structural methods of sloping rip-rap, and rip-rap shall be used in preference to vertical seawalls..." (MS Coastal Program, 1988). Related to this program, the MDMR in coordination with the USACE have initiated plans to include a streamlined permitting process for Living Shorelines (Proceedings of the 14th Biennial Coastal Zone Conference, 2005), which are recognized for increasing the marshes' ability to migrate inland as habitat parameters change. Best management practices are also required for all permitted wetland activities to reduce run-off of sediment and pollutants into adjacent marsh.

Until recently, the majority of management efforts within the Mississippi Sound have been focused on acquisition and protection rather than restoration or creation. Since its inception in 1992, the Coastal Preserves Program has been the primary agency focused on management of emergent wetlands within the Mississippi Sound. In an effort to ease the trend of wetland loss, a bill was presented to the state legislature addressing the use of dredged materials within the Mississippi Sound. Effective July 1, 2010, Section 49-27-61 of the Mississippi Code of 1972 was amended by the legislature to address the requirements for participation in the beneficial use of dredge materials program. The revisions include the mandatory participation in beneficial use programs on permitted activities removing over 2500 cubic yards, provided the material is suitable and a site is available.

The Master Plan for Beneficial Use (BU) of Dredge Material for Coastal Mississippi (2011) identifies some potential sites along the Mississippi coast that could be permitted to accept suitable dredge material for restoration projects. In addition to these potential receiving sites, anticipated sources of material from future dredging projects are also identified. This effort will greatly impact the implementation of emergent wetland restoration and creation by reversing the trend of regional sediment removal through the current practice of offshore and upland disposal of dredged material. Goals for the BU Program include the operation of at least three BU receiving sites in each county to help reduce costs and complexity of BU for dredging applicants and their contractors. Projects are jointly reviewed by the Beneficial Use Steering Committee consisting of representatives from state and federal agencies. Sediment testing is required by MDEQ for all dredge materials intended for permitted BU sites. The first beneficial

use project in the Mississippi Sound began in 2003 with 50 acres of marsh restored on Deer Island. Approximately 100 acres of emergent marsh habitat have been enhanced, restored, or created through the current beneficial use program.

Additionally, there are many restoration opportunities occurring in response to Hurricane Katrina of 2005 and the Deep Water Horizon (DWH) Oil Spill of 2010. In 2009, the State of Mississippi was awarded federal funding for post-hurricane Katrina restoration, and funding related to the DWH oil spill is expected to be available for future restoration efforts. Projects related to these funding opportunities are either in the planning phase or in the beginning phases of implementation, but will undoubtedly play a role in wetland restoration within the Mississippi Sound.

Finally, enhancement of emergent marsh is focused on revegetating damaged marsh, removal of non-native species, prescribed fire where appropriate, and removal of marine debris. Many tons of damaging manmade debris are removed annually from the Mississippi Sound. Even with increased acquisition, management, and restoration of emergent marsh resources, impacts from unregulated activities, non-point source pollution, and sea-level rise will continue to be prominent factors in habitat decline. Therefore, education to increase public awareness about the primary issues affecting emergent marsh resources should remain a principal component of estuarine protection.

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Figure 1. Watershed for Mississippi Sound.

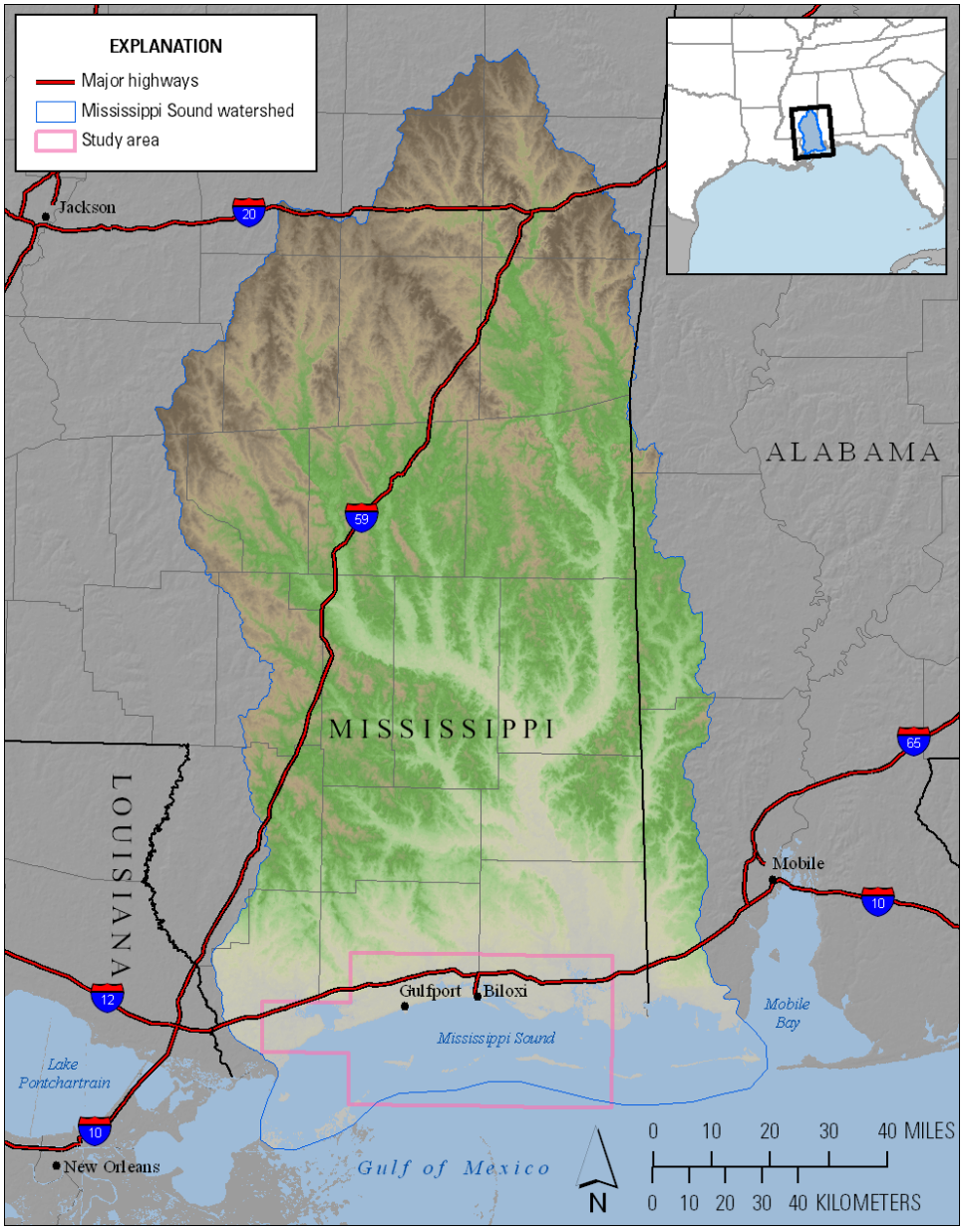

Figure 2. Distribution of emergent wetlands in Mississippi Sound, 1956.

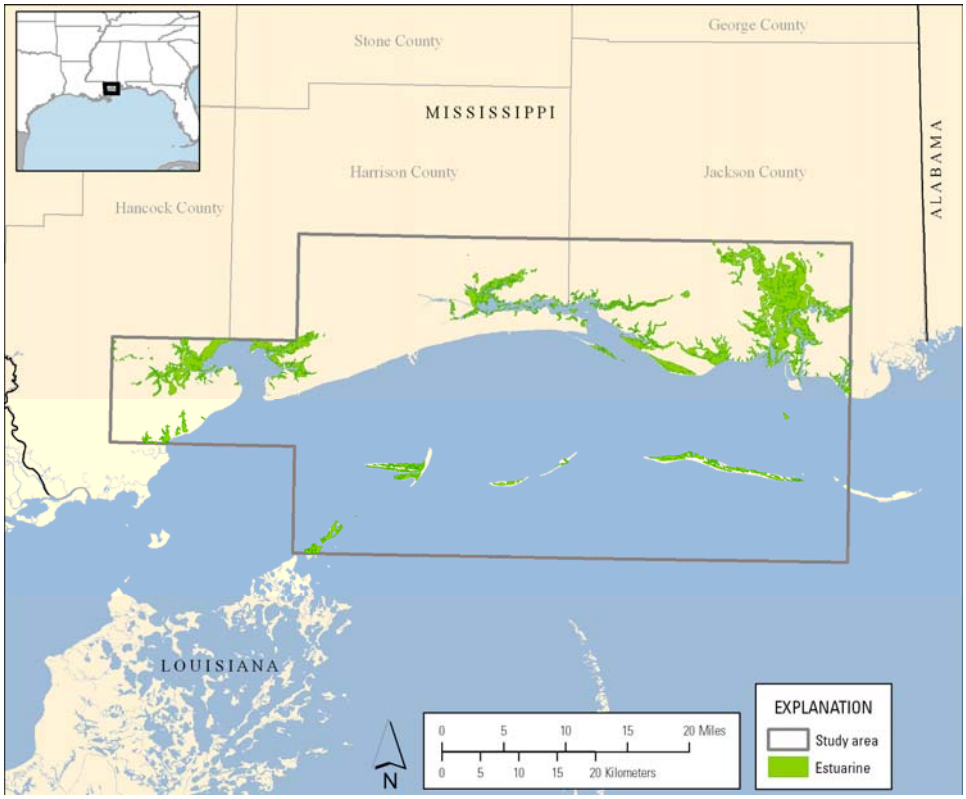

Figure 3. Distribution of emergent wetlands in Mississippi Sound, 1979/82.

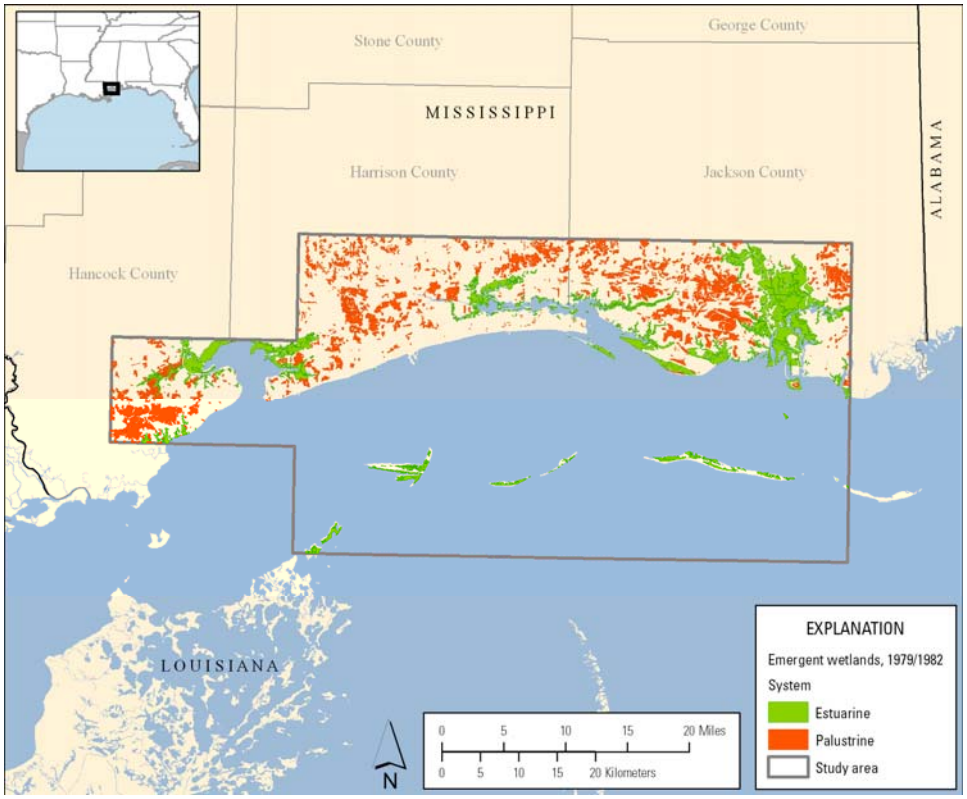

Figure 4. Distribution of emergent wetlands in Mississippi Sound, 1996.

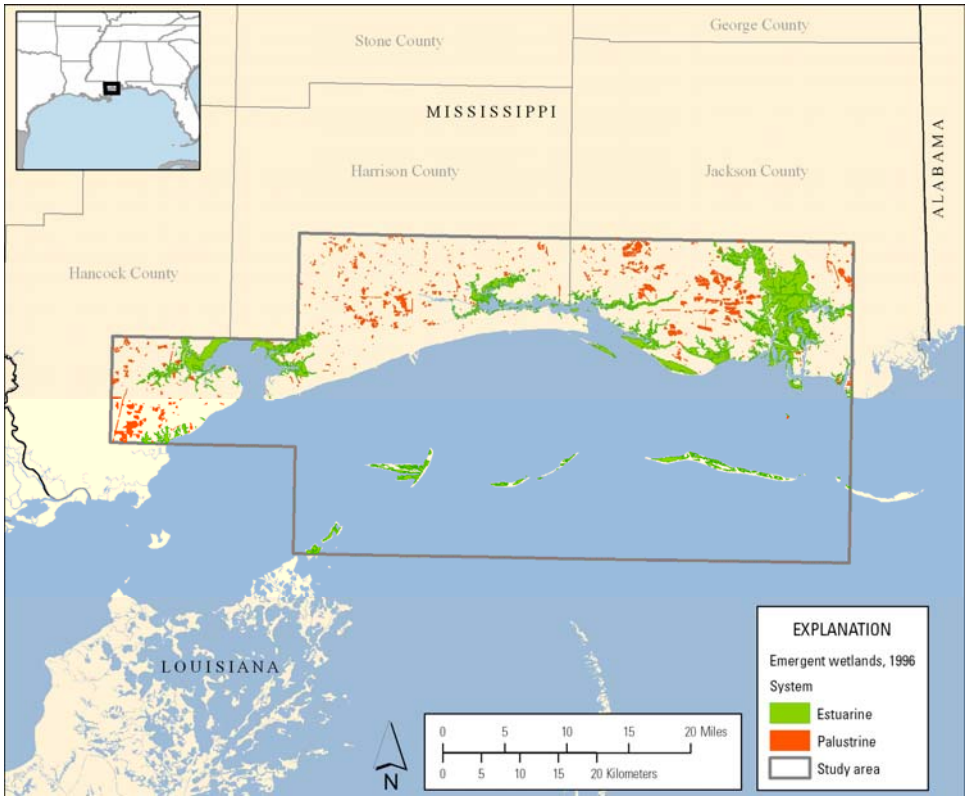

Figure 5. Distribution of emergent wetlands in Mississippi Sound, 2007