



A perfect storm: An archaeological management crisis in the Mississippi River Delta

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Abstract

Engineered projects resulting in unintended consequences, coastal erosion, subsidence, and sea-level rise are rapidly destroying archaeological sites in the Mississippi River Delta (MRD). The processes of site obliteration are intensifying and accelerating due to anthropogenic transformation of the environment, including cumulative engineered alterations of the landscape and climate change. Combined with increased inundation and erosion from storm surges, hundreds of terrestrial sites formerly located on natural levees, barrier islands, and other coastal landforms are progressively eroded, redeposited, deeply buried, and submerged. These include thousand-year-old earthen mounds and shell middens constructed by Native Americans, as well as centuries-old fishing communities along the coast. These irreplaceable cultural properties can provide crucial information on the unique history and ecology of the MRD. Ongoing studies include consulting with interested parties and implementing data sharing agreements. Researchers have formed a consortium of universities and state and federal agencies, and are partnering with culturally affiliated Native American tribes, descendant groups, and coastal communities. The consortium is developing a robust GIS-enabled risk matrix for analyzing threats and effects to endangered sites. It is using the risk matrix to select 30 sites for monitoring, assessment, aerial photogrammetry, and recording environmental data on water table fluctuations. Analysis of action-based scientific data on these imperiled and rapidly disappearing places is urgently needed and will provide the impetus and baseline for future studies. Otherwise, ongoing site destruction will erase any remaining opportunities for learning about Louisiana's deep history and diverse cultural heritage.

Introduction

An unprecedented crisis is unfolding on Louisiana's Gulf Coast. The Mississippi River Delta (MRD) and north-central coast of the Gulf of Mexico contain hundreds of archaeological sites, cultural landscapes, and traditional cultural properties (TCPs) spanning millennia of human habitation in a dynamic wetlands environment. These unique and culturally significant places are rapidly disappearing due to the ongoing erosion of coastal wetlands, subsidence, sea-level rise, storm surges, and more than a century of anthropogenic alterations to coastal landforms and hydrology. The loss of coastal wetlands is occurring faster in Louisiana than anywhere else in the USA (Anderson et al. 2017). The rate of land loss has been estimated at 16.57 square

miles (42.92 km²) per year from 1985 to 2010, or an average of one football field per hour. At least 1,800 square miles (4,662 km²) have been lost since the 1930s, and even more may be lost within this century (Couvillion et al. 2011). The Mississippi River Delta Archaeological Mitigation (MRDAM) project ultimately aims to obtain information on archaeological sites and historic properties as a means of mitigating the ongoing and future loss of cultural heritage (Watt et al. 2019). It should be noted that only through the collection and analysis of empirical data can an actionable and scientific response to the imperiled coast be developed and implemented.

The MRDAM project is supported by the development

of an organizational and partnership-based consortium, the MRDAM Consortium. The consortium's mission is to collaborate with partners and consult with Native American tribes and communities in mitigating the ongoing destruction of sites in the MRD due to coastal erosion, subsidence, sea-level rise, and other alterations of the environment. As the processes of site obliteration intensify and accelerate, opportunities for learning about these unique cultural properties are irretrievably lost and, along with them, crucial yet undocumented sources of information on Louisiana's deep history and cultural heritage.

The MRDAM Consortium is implementing a long-term, cooperative program for rapid survey, site monitoring, and archaeological investigation. Through partnerships, consultations, community outreach, and support for graduate and undergraduate research, the MRDAM Consortium is promoting public education and advancing cultural resource management planning on Louisiana's imperiled coast.

The MRDAM Consortium currently includes researchers at the following universities and agencies:

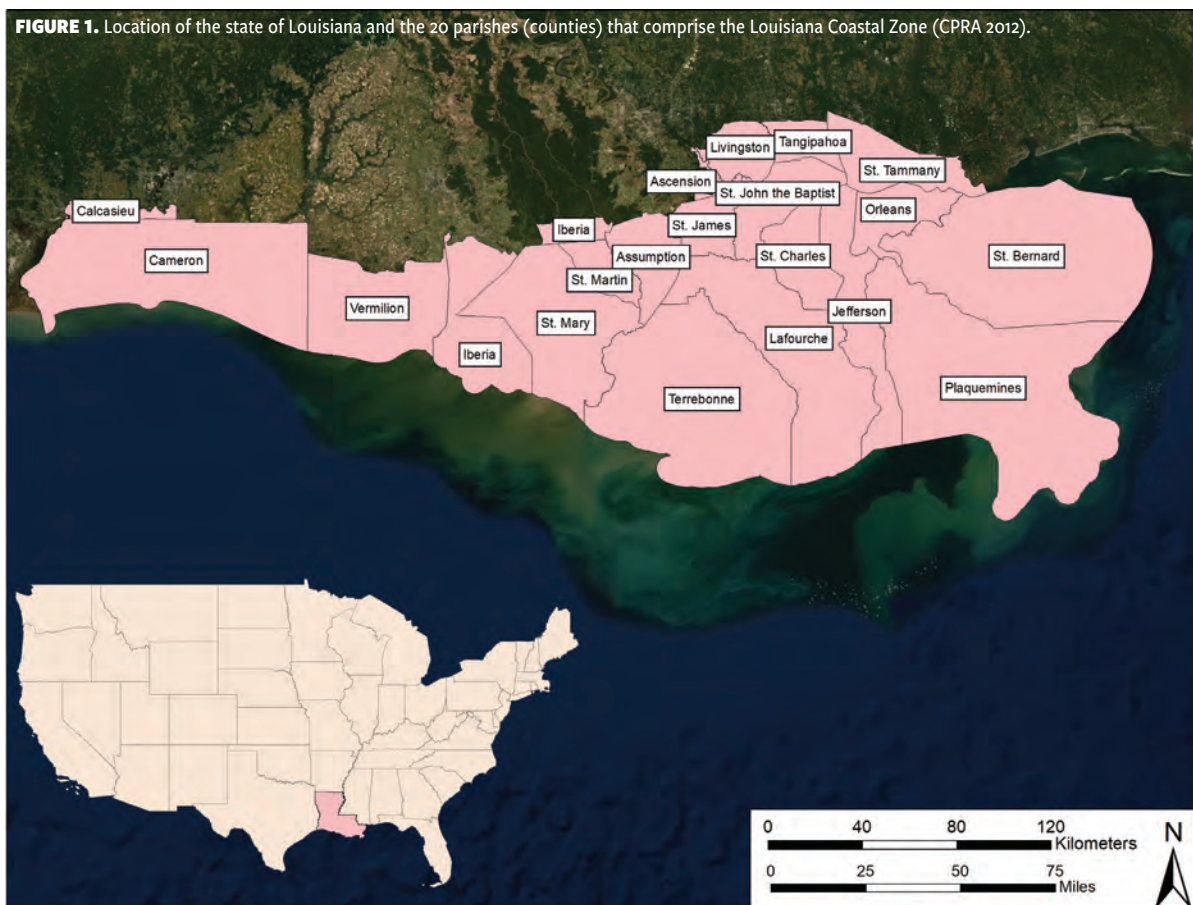
- National Center for Preservation Technology and

Training, National Park Service

- University of Louisiana at Lafayette, Louisiana Public Archaeology Lab
- Tulane University, Department of Anthropology
- Louisiana State University, Department of Geography and Anthropology
- Louisiana Office of Cultural Development, Division of Archaeology
- Northwestern State University of Louisiana, Creole Heritage Center

Background

Human modifications to the MRD and Gulf Coast precede the arrival of Europeans, as Indigenous people were constructing shell middens and ceremonial mounds and altering faunal and floral communities since at least 800 BCE, or as soon as the natural levees, barrier islands, deltaic landforms, and cheniers were inhabitable. Human environmental impacts accelerated during the 19th century with the expansion and intensification of agriculture, livestock ranching, forestry, watercraft commerce, the clearing of waterways, and increased efforts to control seasonal flooding. Today, these anthropogenic and environmental impacts are felt across 20 Coastal Zone (CZ) parishes in south Louisiana (Figure 1). Archaeological investigations



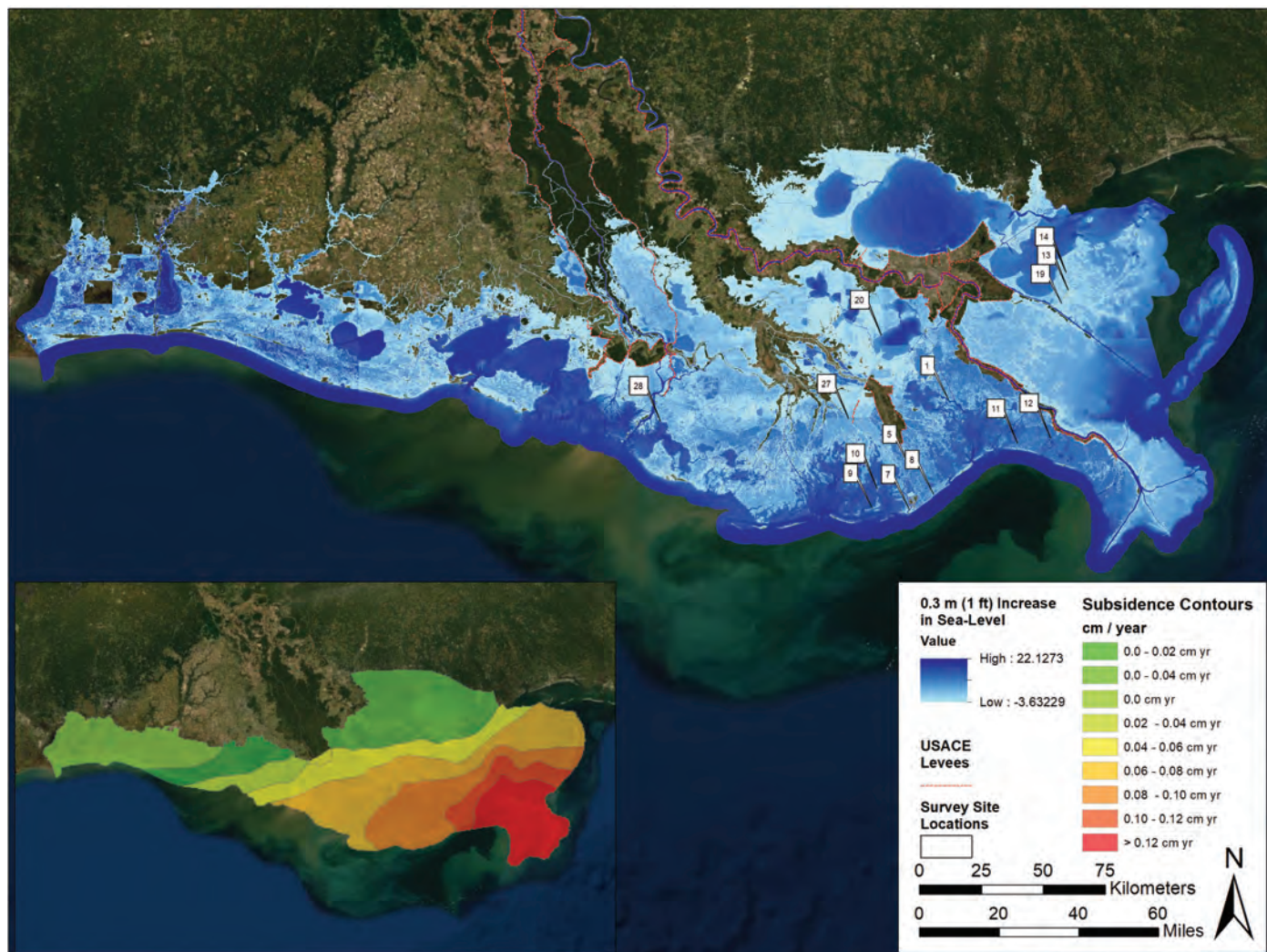
have been conducted in the MRD and coastal zone for nearly a century (e.g., Kniffen 1936), but increased in the 1970s following the passage of federal and state legislation and regulations on the management of cultural resources, historic properties, and cultural landscapes.

The cumulative effects of these natural and anthropogenic processes represent a perfect storm along Louisiana's Gulf Coast, with devastating yet poorly understood impacts on hundreds of archaeological sites and TCPs. Engineered catastrophes have contributed significantly to the inundation, erosion, and redeposition of cultural deposits and surrounding landforms, destroying archaeological contexts, obliterating the archaeological record, and making formerly terrestrial sites increasingly inaccessible and uninhabitable. Sea-level rise and coastal subsidence are producing submerged and deeply-buried deposits that are increasingly difficult if not impossible to study (Figure 2).

As the destruction is ongoing and accelerating, the objectives of the MRDAM project are to implement a proactive, regional program of site monitoring, site triage, and alternative archaeological mitigation. The developing MRDAM Consortium will also generate the requisite archaeological database for future cultural resource management planning before what remains of these important and unique sites is irretrievably lost. Related objectives are to support and increase graduate and undergraduate archaeological research on Louisiana's Gulf Coast (Figure 3).

While unknown numbers of marine cultural resources, such as shipwrecks and submerged archaeological sites, may also be endangered, the ongoing effects of coastal erosion, subsidence, and relative sea-level rise are especially destructive to terrestrial sites that are mainly situated in low-lying, prone, coastal marsh environments. The term "sites" in the following prioritization

FIGURE 2. Projection of a 0.3-m (1-ft) increase in sea level, with subsidence contours across the Coastal Zone (inset map). Numbers indicate locations of sites visited during recent survey.



for mitigation considerations thus denotes terrestrial sites, historic properties, and TCPs. Offshore cultural resources and sites that have become fully submerged or entirely lost to coastal erosion are excluded from that prioritization.

Fundamental to the success of the project is understanding tribal and community perspectives on the management of at-risk cultural resources and TCPs. The following interactions are ongoing for the next stages of the project:

- To consult with the State Historic Preservation Office and compile pertinent information regarding Native American tribes and affiliated tribal historic preservation officers, culturally affiliated groups, and coastal communities concerning sites and TCPs within the MRDAM study area.
- To characterize archaeological sites, historic properties, and TCPs based on input from the interested parties, archaeological integrity, historical significance, components, cultural affiliation, landform, function, research potential, and projected land loss.
- To prepare agreements to share the Louisiana Division of Archeology's geographic information system (GIS) information with Native American tribes, traditional communities, and coastal communities concerning sites in the database (if appropriate). The report will indicate which sites the project partners regard as culturally significant and what, if anything, they would like to see done in terms of data collection and conservation.

Developing partnerships and consulting with tribes and traditional communities is critical for ensuring that any ancestral community concerns regarding TCPs and archaeological resources are addressed when considering mitigation practices.

Analysis

For this project, a GIS database is principally used in the development of the risk matrix. This database synthesizes information from archaeological datasets, archival sources, ethnographic research, coastal geomorphology, and wetlands ecology to facilitate integrated cultural resource management planning.



FIGURE 3. LSU's Dr. Kory Konsoer and student Macy Linton flying the unmanned aerial vehicle.

The resulting risk-based matrix will be used to analyze the impacts of past and future land loss scenarios on archaeological sites, cultural landscapes, and TCPs. The results will advance scientific knowledge of historical ecology, sustainability, and resilience across the CZ of Louisiana and provide a means of assessing archaeological sites, developing mitigation strategies based on risk, and implementing appropriate methodologies for individual sites, cultural landscapes, and TCPs.

Initial analysis of the archaeological record of the 20 coastal parishes by Watt et al. (2019) resulted in the following observations regarding the locations of cultural properties on Louisiana's Gulf Coast:

1. Prehistoric settlement concentrated on natural levees associated with distributary channels. The settlement pattern is linear, following former and current channels and reflecting natural levee morphology.
2. Preferred occupation locations on natural levees include confluences of major and minor distributaries, meander cutoffs, and the cut bank (high side) of point bar associations.
3. Abandoned channels seem to be preferred; active channels are not as heavily occupied.
4. Larger sites are located at distributary confluences and smaller sites are situated on natural levee flanks and distal ends.

Therefore, the following predictions can be derived from those observations:

1. Minor distributaries provide access to specialized ecotones for resource extraction.
2. Site density in low-probability areas—freshwater, brackish, and saline marshes, i.e., interdistributary basins—will be relatively low. These areas will be used for resource extraction and transportation.
3. Sites of all cultural periods will occur at the locations described above, depending on the age of the landform.
4. The predominant prehistoric site type will be shell middens; earth middens will be rare.
5. Initial human occupation is associated with early landform development, but maximum use occurs during the early stages of delta deterioration when biological productivity is highest (i.e., a more stable, low-energy environment).
6. Historic-period sites generally follow the same patterns as prehistoric sites.

Discussion

The development and application of mitigation strategies in times of environmental risk and catastrophe are becoming increasingly common around the globe, especially in regions routinely affected by hurricanes, earthquakes, and other natural disasters (Mitchell 2008; Anderson et. al. 2017; Watt et. al. 2019). The inverse relationship is also being examined: how archaeology might inform present-day responses to relative sea-level rise and climate change through a greater understanding of past human responses to environmental stress (Cooper and Peros 2010). Mitigation strategies are generally utilized for data recovery in cultural resources management when adverse impacts have been deemed unavoidable for historically significant properties or those eligible for the National Register of Historic Places (NRHP). Typically, the rationale of data recovery or excavations for archaeological sites as mitigation is based on Criterion D of the National Register criteria of eligibility: that a site contains or has the potential to yield valuable information on history or prehistory. The adverse effects of an undertaking on an NRHP-listed or -eligible property are said to be “mitigated” through this process of data recovery (Hardesty and Little 2009; King 2013). Three observations are relevant and worth emphasizing here.

First, the mitigation process is generally recognized as destructive to the portion of the archaeological site that is excavated, which will eventually be impacted or destroyed by a planned undertaking. The goal of mitigation is to collect data that will otherwise be lost.

Second, mitigation is most often pursued as an option of last resort, when preservation, avoidance, or other alternatives are not feasible, practical, or agreed upon by the groups involved in consultation (King 2013: 165–167). The reasons are twofold: mitigation is usually the costlier option, and the preference is typically to preserve, conserve, or avoid adverse impacts to historically significant sites. Third, data collection as mitigation prioritizes the scientific, archaeological value of sites as a source of potential information on cultural resources (Hardesty and Little 2009: 78–79). This understanding of sites as sources of information, or resources to be conserved or used, may be different or even opposed to views of sites as places imbued with cultural values and meanings such as heritage, identity, sacredness, ecological knowledge, and tradition.

The following mitigation strategies for MRDAM can be classified under two distinct yet complimentary approaches.

- **Data recovery.** The data recovery process typically involves intensive excavation and analysis of one site. It is the most commonly utilized mitigation strategy for archaeological sites listed or eligible for listing on the NRHP when it becomes necessary to reduce the adverse effects of a proposed undertaking or action.
- **Alternative mitigation.** Other strategies (listed below) may be preferable to data recovery in many of the instances outlined in this report for the MRD and CZ. Due to the ongoing subsidence, submergence, and erosion of so many sites, traditional data recovery may be cost-prohibitive and unfeasible. Research questions may not necessitate large-scale or intensive data recovery excavations.

The Advisory Council on Historic Preservation (ACHP) recognizes the value of alternative mitigation measures and encourages creative substitutes for data recovery, particularly when developed and carried out through consultations and with community and public involvement. Such measures may include active preservation of NRHP-eligible sites that are not endangered or are outside of a defined Area of Potential Effect, instead of, or in addition to, data recovery at a site to be adversely affected.

The risks and challenges to archaeology in an eroding MRD are not solely issues of the Gulf South. Similar challenges are being experienced in delta and estuarine landscapes across the globe, with dramatic impacts to both living populations as well as historic and prehistoric cultural resources where sea-level rise and sub-

sidence are demanding a rapid and effective response to catastrophic or widespread cultural resource loss (Anderson et al. 2017; Watt et. al. 2019). Sites at risk are united under the dire threat of climate changes that are adversely affecting cultural resources at a faster rate than can be satisfactorily mitigated at a traditional data recovery scale. Balancing research and rescue are critical in selecting alternative mitigation strategies for sites in the MRD, which include:

- **Salvage mitigation.** Salvage involves intense and often rapid recovery of as much data as possible from one or more sites in imminent danger of destruction. Salvage implies a timeframe of unavoidable damage and often the unrealizable goal of total data recovery.
- **Triage mitigation.** Triage mitigation prioritizes sites by the highest risk of adverse impacts and may thus include sites prioritized for salvage mitigation. Sites identified for triage have a wide range of research potential, expanding the opportunity for data recovery. These sites are also recommended to be eligible or potentially eligible to be listed on the NRHP.
- **Sample mitigation.** Site sampling as a form of mitigation is regional or topical in scope, driven by research questions and the potential for the advancement of knowledge. In contrast to salvage and triage, the degree of risk for subsidence, inundation, and/or loss to coastal erosion may be of lesser importance.
- **Mitigation banking.** This form of mitigation is recognized as a possible alternative involving the substitution of one site for another. The sites may

then be regarded as somehow comparable, as the investigation or conservation of one site is seen as effectively counterbalancing or resolving the adverse effects on the other. While data collection through excavation is possible under mitigation banking, it is not required.

- **Creative mitigation.** Essentially equated with “alternative mitigation” by the ACHP, this approach to mitigation comprises various unspecified strategies, intended to encourage discussion and consideration of alternatives during consultations. Two possibilities not considered here, but discussed by the ACHP (2009), are the production of regional syntheses and development of educational resources.

A field reconnaissance survey conducted during 9–17 September 2019 ground-truthed the GIS data compiled during the initial phase of the MRDAM project. The survey consisted of shoreline survey, visual inspection, drone-assisted aerial photogrammetry of at-risk archaeological sites, including earthen mounds and shell middens (Figures 4 and 5).

Conclusion

Sea-level rise over the next 50 years will inundate the vast majority of the Louisiana Gulf Coast. Already low-lying, flood-prone parishes will experience additional stresses from increased rates of subsidence. Documentation of these resources indicates that the rate of land loss and sea-level rise on the coast has already resulted in considerable impacts to cultural resources that were once intact terrestrial archaeological sites. These impacts were identified at shell middens as well as mound sites with several sites being wholly submerged and many amid active erosion.

Environmental and anthropogenic-driven impacts to all of these sites are expected to increase in intensity. The crisis on the coast is by no means a passive or long-term process for many archaeological sites. Impacts have been ongoing for decades, and the resulting loss will inevitably be a near-total loss for the state of Louisiana and the broader cultural heritage of the United States. The current analysis, consultation with community partners and organizations, the development of a robust partnership consortium, and data recovery and prioritized mitigation strategies

FIGURE 4. Typical earthen mound site in the marsh.



will continue to underscore the mission of the MRDAM project. By better understanding the environmental processes and engineered effects that are rapidly eroding these archaeological sites, we can implement action-based mitigation strategies, thereby improving understanding of the collective cultural heritage of the Gulf Coast of Louisiana and preserving and protecting this endangered scientific information for future generations.



FIGURE 5. Inspecting an eroded shell midden.

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