Environmental Studies Program: Ongoing Study

Title	Investigation of an Ancient Bald Cypress Forest in the Northern Gulf of Mexico: Phase 2 (GM-19-04-01)
Administered by	GOM OCS Region
BOEM Contact(s)	Douglas Jones (douglas.jones@boem.gov)
Procurement Type(s)	Cooperative Agreement, Interagency Agreement
Conducting Organization(s)	Louisiana State University and U.S. Naval Research Laboratory
Total BOEM Cost	$538,235 ($498,235 [LSU] + $40,000 [NRL])
Performance Period	FY 2020–2023
Final Report Due	August, 2023
Date Revised	August 10, 2021
PICOC Summary	
Problem	The BOEM-funded 2015–2018 pilot study provided significant baseline data on the submerged Cypress Forest; however, some of the analyses, including geophysical rectification of buried features, specimen dating, and pollen profiles, proved imprecise or inconclusive due to methodology and equipment tested and applied.
Intervention	Incorporate three-dimensional (3-D) sub-bottom survey to the complement of geophysical survey techniques and collect 10 m vibracores at the site to obtain a deeper, continuous sedimentary record of lithic, peat, pollen, and foraminifera samples.
Comparison	This study will produce geophysical rectification of buried features, specimen dating, and pollen profiles, not fully achieved in previous analyses.
Outcome	Geophysical resolution of buried features including tree stumps, accurate dating of buried foraminifera and other botanical and faunal remains, and a more refined pollen profile—all of which will allow scientists to create a more accurate model of successive paleoclimate regimes and associated ecological systems.
Context	The Submerged Cypress Forest is a preserved, partially buried Pleistocene landform with intact tree remains still in growth position located ~13 miles off the coast of Alabama on the Gulf of Mexico (GOM) continental shelf.

BOEM Information Need(s): BOEM devotes considerable resources to carrying out its mission to identify and preserve the Nation's natural and cultural resources as per the National Historic Preservation Act (NHPA) of 1966 and the National Environmental Policy Act (NEPA) of 1969. However, there is a gap in understanding how the presence of preserved landforms such as submerged forests and marshlands, which contain valuable information of past ecosystems, climate, and physical geology/geography, fits within this realm and how the geological and geophysical characteristics of these submerged terrestrial habitats interplay with BOEM's Outer Continental Shelf (OCS) management needs and objectives. The information developed by this study may subsequently be used by BOEM to: (1) develop more effective survey methods for detecting and characterizing such seabed features, many of which are associated with intact, valuable sand resource deposits, and (2) determine if environmental analyses are necessary for such sites when relevant to proposed oil, gas, and dredging activities.

Background: In late 2004, local divers found a location on the OCS in ~60 ft. of water with abundant fish ~13 mi. south of Orange Beach, Alabama after Hurricane Ivan made landfall nearby on September 16 of that year. Diver surveys in 2013 found the depression contained layers of clay sediments with well-preserved woody remnants and several tree stumps exposed or partially exposed. Radiocarbon dating of the wood and woody remnants and remnants and optically stimulated luminescence (OSL) dating of the sediment cores collected from the site suggests the forest age and burial occurred ~42–70 ka. From 2015–2018, in partnership with the Coastal Marine Institute program at LSU, BOEM funded a study to achieve the objectives listed below (DeLong *et al*. 2020). This study successfully produced excellent data and information to achieve these goals (*e.g.* Gonzales *et al.*, 2017 and Reese *et al.*, 2018); however, some of the analyses, including geophysical rectification of buried features, specimen and site dating, and pollen profiles, proved imprecise or inconclusive due to methodologies used and equipment tested.

Objectives: The objective is to refine the characterization of a submerged Pleistocene landform in the northern GOM that contains well-preserved ancient bald Cypress stumps to improve the precision of previously developed information on the geological, geophysical, ecological, and paleoenvironmental characteristics of this site type. By establishing the place of the submerged Cypress forest site within the sedimentological context of the GOM, this research will:

- develop a model to predict other submerged paleoforest sites within the GOM by
- determining the preservation characteristics of the site; and
- improving understanding of the site's depositional and geomorphic characteristics.

Methods: The following methods and tasks are planned for this study:

1. Use high-resolution 3-D compressed high-intensity radar pulse (CHIRP) sub-bottom profiler and tight line spacing to resolve the shape and position of tree stumps and other unusual features at the main site identified by Phase 1 study.
2. Ground-truth geophysical survey targets using divers.
3. Collect 10 m vibracores at several locations throughout the main site to obtain a deeper, continuous sedimentary record of sedimentary, peat, and pollen samples than was previously obtained.
4. Expand geophysical survey area to other (~1–2) known buried tree sites in the northern central GOM.
5. Use established dating methods (radiocarbon, OSL, floating tree ring) to compare the age of sediments and the subsequent sedimentation rates to calculate the ages of the *in situ* tree stumps.
6. Examine microfossils in the sediments for shifts from terrestrial-freshwater conditions and marine species, particularly for the new 10 m cores.
7. Refine the paleoenvironmental setting of the forest through pollen and tree-ring analysis.
8. Refine the model to predict other buried forest sites in the northern GOM.

Specific Research Question(s):

1. What are the geophysical characteristics of wood buried in sediments in an offshore setting?

2. What types of geomorphology and related ecosystems allow for preservation of wood on 10,000-year time scales?
3. How important are coastal processes and/or climatic shifts to the preservation of wood on these timescales?

Current Status: In 2021, a high-resolution geophysical survey was conducted at the Phase 1 study area and two newly identified study areas to determine current site conditions and any bathymetric changes due to 2020 tropical storm activity. Additionally, the 10-m vibracore collection was attempted at the main Phase 1 site. Data analysis for these two efforts is ongoing and additional fieldwork will be scheduled in 2022.

Publications Completed: None

Affiliated WWW Sites: None

References:

DeLong KL, Bentley Sr SJ, Xu K, Harely GL, Reese CA, Obelcz J, Gonzalez S, Truong JT. 2020. Investigation of an ancient bald cypress forest in the Northern Gulf of Mexico. New Orleans (LA): US Department of the Interior, Bureau of Ocean Energy Management. Report No.: BOEM 2020-034.

Gonzalez, Suyapa, Samuel J. Bentley Sr., Kristine L. DeLong, Kehui Xu, Jeffrey Obelcz, Jonathan Truong, Grant L. Harley, Carl A. Reese, Alicia Caporaso, 2017. Facies Reconstruction of a Late Pleistocene Cypress Forest Discovered on the Northern GOM Continental Shelf, Gulf Coast Association of Geological Societies Transactions, 67, 133–146.

Reese, Carl A., Grant L. Harley, Kristine L. DeLong, Samuel J. Bentley Sr., Kehui Xu, Suyapa Gonzalez, Jonathan T. Truong, Jeffrey Obelcz, and Alicia Caporaso, 2018. A Stratigraphic Pollen Record from a Late Pleistocene Cypress Forest, Northern Gulf of Mexico Continental Shelf, Journal of Quaternary Science, 33(8), 865–870.