

## **ENVIRONMENTAL STUDIES PROGRAM: Ongoing Studies**

**Region:** Gulf of Mexico Region

**Planning Area(s):** Central

**Title:** A Comparative Analysis of an Oil Spill on the Biota Inhabiting Several Gulf of Mexico Shipwrecks: Archaeological Analysis (GM-13-03b)

**BOEM Cost:** \$438,427.10

**Period of Performance:** FY 2013-2016

**Conducting Organization(s):** C&C Technologies, Inc. (M13PC00021)

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### **Description:**

**Background:** As amply demonstrated in BOEM's award-winning 2004 study entitled *Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico* (Church et al., 2007), such archaeological sites serve as an ideal sample because they are located at random throughout the study area and have a diverse array of organisms, both macro and micro that inhabit each of these sites. The 2004 study collected baseline data providing information on the environment at each site, a determination of the physical and biological modification of sediments in the immediate area of each site, limited sampling of the fauna attached to hard substrate for taxonomic studies, and an analysis of hundreds of hours of video imagery and sample collection to address spatial heterogeneity of the fouling community and motile fish and invertebrate association with the wrecks. In addition, archaeological assessments and site plans were created for each of the study shipwrecks along with an analysis of the structural integrity and current state of preservation to understand the individual formation processes occurring at each site. Limited, bio-chemical analyses were conducted to identify microbial metabolic potential at each site and to determine if decay (rust formation) was accelerating at any or all of the mid-20th century shipwrecks assessed. This critical analysis was key to understanding the decay processes occurring at each site and for determining if any of these sites' hulls would eventually become compromised and potentially release contaminants and/or hazardous materials contained within the vessels at the time of their sinking. Most of these sites have not been revisited since the conclusion of this pilot study in 2004, and this study did not include wooden shipwreck sites or sites on the continental shelf. Considering the overall lack of archaeological survey and environmental data among the Gulf of Mexico's shipwreck sites, the site formation processes and possible negative impacts associated with a large-scale oil spill over time are unknown.

Post-spill investigations of several deepwater coral colonies in 2010 have, to date, identified one colony to the southwest of the Macondo well that exhibited stress from possible exposure to oil (White et al., 2012). Using gas chromatography and other analyses, researchers concluded that the corals had indeed been exposed to oil, likely from the DWH spill. However, these investigations have not collected wood or metal

samples from shipwrecks to determine whether the hulls were exposed to oil and, if so, how exposure to hydrocarbons may affect site formation processes, state of preservation, and rates of degradation. If exposure to oil/dispersant accelerates the degradation of metal and/or wooden-hulled vessels, the long-term survival of resident coral communities as well as the availability of suitable hard structure (shipwrecks) for future coral colonization may be negatively impacted.

C&C Technologies is performing the archaeological tasks associated with this contract. The study is part of an overall multi-partner effort that is performing multidisciplinary analyses to determine if shipwrecks and their resident microbial communities were impacted by the 2010 oil spill. This work is being conducted in conjunction with other study partners including BOEM, George Mason University, the U.S. Naval Research Laboratory, and Bureau of Safety and Environmental Enforcement (BSEE).

#### Objectives:

1. Collect, process, and analyze 3-D scans (acoustic or optical) of specific diagnostic hull features and associated resident biota on selected shipwreck sites in the GOM;
2. Conduct systematic visual surveys using a Remotely Operated Vehicle (ROV) to analyze and compare with previously collected ROV video data;
3. Update previously generated archaeological site plans or produce new site plans as needed; and
4. Using these data, identify changes in site stability and degradation over time.

A public outreach component of the study includes the production of video clips of the shipwrecks and field cruises as well as a Summer Professional Development (PD) Program developed and implemented by C&C's subcontractor, the PAST Foundation.

**Importance to BOEM:** This study will support EIS development and decision-making by providing documentation and analysis of a major oil spill's prospective lasting effects on shipwrecks, which have been demonstrated in previous BOEM studies to serve as deepwater artificial reefs for various biota. Section 106 of the National Historic Preservation Act requires Federal agencies to consider the potential effects of their permitted activities on cultural resources before issuing such permits but impacts to shipwrecks from oil spills such as the *Deepwater Horizon* spill of 2010 are unknown. Archaeological investigations conducted after the Exxon Valdez oil spill in Alaska focused on terrestrial sites even though post-spill surveys identified submerged cultural resources within the affected area. Additionally, damages to cultural resources are not addressed by the Natural Resource Damage Assessment process, and no other studies are currently analyzing these potential impacts. General questions to be addressed in the study include whether and how oil, dispersed oil, and chemical dispersants used to manage the oil spill interact with and are integrated within the shipwreck remains, resident biota, and surrounding seafloor. This study will also analyze each chosen vessel's current state of preservation, its site formation processes over time, the

degradation of its hull structure (iron, steel, or wood), and associated material remains. Microbial action and resident biota at each test site will also be systematically analyzed to determine if exposure to hydrocarbons and dispersant-based chemicals cause any long term impacts. Baseline data collected at selected sites before the 2010 DWH spill will be used for comparative purposes.

**Current Status:** The contract to C&C Technologies was awarded on September 20, 2013. Project partners completed two field cruises in March and July 2014 on board the Louisiana Universities Marine Consortium (LUMCON) Research Vessel *Pelican*. The team collected water, sediment, wood, metal/rusticle, and coral samples from a total of seven shipwreck sites. A long-term microbiological experiment deployed at U-166 in 2003 was retrieved for corrosion analyses to be performed by C&C's subcontractor, Droycon Bioconcepts. C&C integrated a 2G Robotics 3-D sonar scanner with the ROV to collect 3-D scans of select features on several of the shipwreck sites.

During separate field efforts performed as cruises of opportunity during C&C surveys of offshore oil and gas leases, C&C deployed their Autonomous Underwater Vehicle (AUV) to collect acoustic, visual, and optical data at several of the shipwreck sites. The AUV collected high-resolution swath bathymetric, side scan sonar, and sub-bottom profiler data; 3-D laser scans; and high-resolution digital photographs of the shipwrecks. Data analyses are nearly complete. C&C is developing 3-D renderings of the merged 3-D laser and 3-D sonar scans and video clips of each shipwreck site as a deliverable. The draft report is currently being compiled by the study partners and is anticipated in March 2015.

The Summer Professional Development Program component provided a direct connection between study participants and students and teachers engaged in the Project Lead the Way (PLTW) and Sea Perch STEM programs. During the first field cruise, scientists communicated directly with students and teachers using the web-based program Basecamp. In summer 2014, middle school, high school, and college students began their initial efforts for participating in a ROV competition that will be held in May 2015. In this competition sponsored by and held at the Center of Science and Industry (COSI) in Columbus, Ohio, students are required to design, build, and operate an ROV as well as complete certain scientific tasks in a pool. COSI students participating in these programs were introduced to and inspired by the study's research questions, unique challenges, and techniques for conducting science in deep water.

**Final Report Due:** March 2016

**Publications:** Various articles intended for peer-reviewed publications are currently being drafted.

Information about this study has been presented at:

- 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference (poster),
- 2014 Society for Historical Archaeology conference (1 paper), and
- 2014 American Geophysical Union Fall Meeting (poster).

Conference presentations in 2015 will include:

- 2015 Gulf of Mexico Oil Spill & Ecosystem Science Conference (1 paper),
- 2015 Society for Historical Archaeology conference (1 session consisting of 10 papers, 1 poster),
- 2015 Society for American Archaeology conference (1 paper), and
- 2015 Federation of European Microbiological Societies' (FEMS) 6<sup>th</sup> Congress of European Microbiologists.

Press releases: **7/21/2014** – Gulf of Mexico Shipwreck Study Launches Second Expedition on the Research Vessel Pelican. <http://www.boem.gov/press07212014/>

**Affiliated Web Sites:** [http://mbac.gmu.edu/mbac\\_wp/gulf\\_wrecks/](http://mbac.gmu.edu/mbac_wp/gulf_wrecks/) and <http://www.boem.gov/GOM-SCHEMA/>

**Revised Date:** December 12, 2014

**ESPIS: Environmental Studies Program Information System**

**All completed ESP studies can be found here:**

[http://www.data.boem.gov/homepg/data\\_center/other/espis/espisfront.asp](http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp)