

Technical Announcement

MMS

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Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico: Artificial Reef Effect in Deep Water

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The Minerals Management Service (MMS), Gulf of Mexico OCS Region, announces the availability of a new study report, *Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico: Artificial Reef Effect in Deep Water*.

The report presents the results of a study to investigate the artificial reef effect of World War II shipwrecks in the deepwater region of the Gulf of Mexico, a joint partnership between MMS and NOAA's Office of Ocean Exploration, through the National Oceanographic Partnership Program (NOPP). The study comprised a biological and archaeological investigation of seven World War II shipwrecks in water depths ranging from 400 to 6,500 feet (122 to 1,981 meters).

The biological aspect of this study approached one basic question: Do man-made artificial structures or objects, *i.e.*, shipwrecks, function as artificial reefs in deep water? Although there is not yet a complete understanding of how artificial reefs function on the continental shelf, particularly in the photic zone above 100 meters (328 feet), it is generally accepted that artificial reefs can serve a positive function by the creation of new hard-bottom habitat in areas where hard bottom is naturally lacking (most of the Gulf of Mexico).

The archaeological objective of the study was to ground-truth, document, positively identify, and assess the National Register status of seven wrecks sunk during World War II. This objective required historical research and field investigation to be conducted for each site.

This study focused on seven shipwrecks lost during the mid-twentieth century. Historically, this group of shipwrecks represents two distinct periods in America's past. The historical significance of each wreck is related to the historical period it represents. The freighters *Alcoa Puritan* and *Robert E. Lee*, and the tankers *Gulfpenn*, *Halo*, and *Virginia*, for example, are

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reminders of World War II. On a regional scale, these wrecks emphasize that the war came closer to the United States mainland than most Americans are aware.

Of the seven wrecks designated for this study, only four (*Alcoa Puritan*, *Anona*, *Robert E. Lee*, and *U-166*) had been positively identified before the project. The remaining vessels (*Gulfpenn*, *Halo*, and *Virginia*) had only been tentatively identified. Water clarity at the *Gulfpenn* and *Halo* sites allowed relatively easy confirmation of the vessel's identity on the basis of structural and hull characteristics. At the *Virginia* site, however, limited visibility and sedimentation made positive identification difficult. Close examination of the site's physical evidence and historical documentation confirmed the vessel is the *Virginia*.

With the exception of the *Virginia* and *Anona*, the extent of the debris fields (wreck site boundaries) had been determined during the 2004 project. An investigation of the debris scatter at the *Virginia* site was not undertaken because of poor visibility, and the geophysical data did not indicate substantial scatter debris at the site. Tropical Storm Bonnie prevented investigations of the *Anona* site. *Anona*'s assessment as presented in this report is based on the 2002 investigations that were limited to the main hull wreckage. Investigations at all but one wreck site indicated a relationship between water depth, ship size, and the extent of the debris scatter. Based on this information, a preliminary model for determining the extent of deepwater wreck sites for this group of ships was developed. Future data acquisition and testing will be required to further refine the model.

The condition, state of preservation, and deterioration rate for each shipwreck, as well as potential environmental impact, was assessed. In general, there was a correlation between the wreck's state of preservation and depth in this area of the Gulf of Mexico. Sediment core samples taken at various locations at each wreck site indicated the wreck sites are not contaminating or adversely impacting the surrounding seafloor at this time.

In the current study, the artificial reef effect of World War II shipwrecks, which may serve as surrogates to infer potential effects of deep-sea drilling structures on biological communities, was examined. All six of the shipwrecks originated from the same period, May to late July 1942, and are aligned along a depth gradient from 87 to 1,963 meters (285 to 6,440 feet) depth.

Shallower sites of the *Virginia* and *Halo*, nearer the outflow of the Mississippi River, were coated with thick layers of dendritic concretions and biofilms (slimes). Sea anemones were most abundant on *U-166* and particularly the *Robert E. Lee*. *Alcoa Puritan* is estimated to be paralleling the *RMS Titanic*'s (sunk 30 years earlier in 1912) rusticle growth pattern based on the *Titanic* deterioration model.

Many rare or uncommon invertebrate species were encountered in this study. Species richness (the number of species) and abundance of organisms were higher *near* the shipwrecks in comparison to *away* from the shipwrecks. This generalization holds primarily for species associated with hard substrates. Increased turbidity and resource limitations may explain decreased abundance at various sites. A strong bathymetric component was evident in the distribution of many taxa, particularly the crustaceans. A comparison of within-site species richness, near (<61 meters or 200 feet) and away from (>61 meters or 200 feet) from the

shipwrecks, supports the argument that the hard substrate afforded by the shipwrecks supported a higher species richness, and increased abundance of organisms, at all sites.

Ichthyfaunal diversity generally decreased with depth. Reef fishes were present at the three shallowest sites, where hard and soft corals were members of the fouling community colonizing the ships, but absent from the three deepest wrecks. This general trend was expected prior to the study. Ichthyofauna documented at the *Gulfpenn* site were characteristic of deepwater hard-bottom areas, such as *Lophelia* reefs, located at similar depths in the north Atlantic. The fish community differed over versus away from the three shallowest wreck sites, but no difference was observed among transect locations at the three deepest wreck sites. The fish community over the three shallowest wrecks (*Virginia*, *Halo*, and *Gulfpenn*) was dominated by depth-specific reef taxa. At the deepest wreck sites, however, community structure and fish density estimates were not significantly different *over* the ships versus *away* from the ships. Therefore, we infer the three deepest shipwrecks in this study conveyed little if any artificial reef effect to fishes found at those depths. No general trend was observed in the fish community *over* the wrecks versus *away* from the three deepest wreck sites (*U-166*, *Robert E. Lee*, and *Alcoa Puritan*).

The dense *Lophelia* colonies associated with the *Gulfpenn* may have been among the more dramatic finds in the study. These deep coral habitats associated with the shipwrecks permitted one of the deeper studies of true reef fishes in the northern Gulf.

This report is available only in compact disc format from the Minerals Management Service, Gulf of Mexico OCS Region, at a charge of \$15.00, by referencing OCS Study MMS 2007-015. The report may be downloaded from the MMS website through the [Environmental Studies Program Information System \(ESPIS\)](#). You will be able to obtain this report also from the National Technical Information Service in the near future. Here are the addresses. You may also inspect copies at selected Federal Depository Libraries.

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