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SESSION 1E

THE MMS SEA FLOOR MONITORING PROGRAM

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Co-Chair: Dr. Jack Irion

Date: December 17, 1997

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More recently, the Government Performance and Results Act of 1993, as amended in 1997 requires federal agencies to report on their performance in terms of measuring "Outcomes" that result from their activities, rather than outputs. Or more specifically, how effective is MMS in ensuring environmentally sound OCS operations.

Although many environmental effects are difficult to measure, it is the responsibility of the MMS to ensure OCS operations are carried out in an environmentally sound manner.

The initial phase of the MMS Monitoring Program will focus on expanding compliance monitoring: first, by requiring operators to demonstrate compliance with avoidance requirements by providing As-built maps showing anchor locations with their construction reports; secondly, through field checking by MMS personnel to verify that protected features were avoided using high resolution side-scan sonar and/or MMS divers.

A pilot project was initiated in 1997 to test the effectiveness of these measures of evaluating the condition of the sea floor. Dr. Jack Irion will describe the methods and projects undertaken during this pilot project.

Nicholas Wetzel is Supervisor of Unit II, Environmental Operations Section of the Minerals Management Service's Gulf of Mexico OCS Regional Office. His graduate work (University of California, Fresno: MS 1978) addressed the paleoecology and carbonate petrology of a Devonian stromatoporoid reef at Mountain Springs Summit, Nevada. He has been involved with conducting post-lease environmental reviews for the MMS since 1996. Prior to his work with MMS, he spent 18 years with the U.S. Bureau of Mines where he performed hundreds of pre-feasibility studies of mineral properties, which included reserve/resource estimation, mine engineering and design, metallurgical engineering and design, cost estimation, and mineral economics. He served as advisor to the Senate subcommittee for Energy and Minerals during the California Desert Conservation Act hearings and has provided expert testimony in validity hearings and other mineral related litigation.

THE WHAT, WHERE, WHY, AND HOW OF MONITORING THE SEA FLOOR

Dr. Jack B. Irion
Minerals Management Service
Gulf of Mexico OCS Region

The MMS' Pilot Seafloor Monitoring Project provides tangible evidence of whether or not we're doing a good job in extracting hydrocarbons from beneath the sea in a way that preserves the quality of the underwater world. The following are the goals behind the Project, the methods we used to accomplish these goals, and a brief summary of this year's investigations.

MMS is charged with the responsibility of developing mineral resources on the outer continental shelf in an environmentally sound manner. This includes protecting marine mammals from harm during platform removals, preserving air quality by limiting the amount of emissions from offshore platforms, and protecting our coastlines from oil spills. These are all areas that are continually monitored, not only by MMS, but also by the Environmental Protection Agency, National Marine Fishery Service, and the operators themselves.

What is harder to monitor, because it is out of view, is the condition of the sea floor itself. Few people may, in fact, realize that the floor of the Gulf of Mexico is not just a featureless plain of sand and mud but includes spectacular coral reefs like the Flower Gardens, rocky outcrops pushed to the surface by salt domes, and ancient reef systems that formed during the last Ice Age when the continental shelf was dry land. These features are home to diverse variety of life ranging from tiny bristle worms to whale sharks. Even in the deep ocean, the sea floor is home to many unique species, including the methane-synthesizing “ice worms” only recently discovered.

Oil and gas development has the potential to effect the sea floor habitat in a variety of ways, but the most dramatic form comes during the laying of pipelines and the construction and removal of platforms. The large anchors that are used by pipeline lay-barges and construction barges can weigh up to 5 tons, can be dropped dozens of times during a single project, and frequently can be dragged for hundreds of feet, furrowing the sea floor like a gigantic knife. Compared to the relatively limited impact of a pipeline trench, these anchor scars have the potential for causing considerable damage to fragile sea floor habitats and other protected features such as historic shipwrecks. For some time MMS has required operators to avoid these features with their anchors, but no means existed to demonstrate compliance. The Environmental Operations Section was tasked with developing a program to test industry compliance and to gauge the effectiveness of MMS mitigations in protecting sea floor features.

The use of a Remotely Operated Vehicle (ROV) carrying a video camera was initially discussed. However, while these are wonderful tools for documenting specific targets, those of us involved in shipwreck research argued that they were too limited in their view range to make them effective search tools if you didn't know the precise location where damage might have occurred. They also are expensive, often require a good sized operating platform with a lifting boom, and are of limited usefulness in areas with strong currents and turbid waters.

Operating under the current government philosophy of doing more with less, we opted instead for a highly portable side-scan sonar system that could be operated from virtually any vessel with a 12-volt power source. The device consists of the towfish, 200 meters of cable, and a special board that mounts in a standard PC. In this case, the PC is ruggedized and splash-proofed, but it's basically just a 486 running Windows.

The side-scan sonar bounces sound off objects and measures its rate of return to image objects much the same as a camera uses light. The higher the frequency of the sound source, the more times an object is “pinged” and the greater the resolution is of the image. After a considerable amount of research, MMS procured a Marine Sonics 600 kHz sonar. By comparison, the standard sonar in use

in the Gulf is only 100 kHz. This same equipment, incidentally, is now being installed in the Navy's Nuclear Research Sub, NR-1. MMS had it first.

We had a number of requirements in selecting the tool to be used on this initiative, but the principal one was the ability to obtain good quality, highly detailed images of sea floor features. This test image around a dock shows fallen pilings and even automobile tires. We also wanted to be able to use this equipment in a wide variety of depths yet still keep it light and easily manageable by two people. We limited ourselves to the phototropic zone of 300 feet, the depth of the pinnacle features on the edge of the shelf break that are an important biological resource. This allowed us to store the necessary 200 meters of cable on a small reel without requiring special davits or winches. This depth limit allows us to image nearly all the sea floor features that MMS seeks to protect by stipulation except chemosynthetic organisms, which only occur below 400 meters.

Another important criterion of the device was to be able to image small objects on the sea floor. We felt this would be a useful tool for verifying site clean-ups after structure removals. The 600 kHz side-scan clearly images things as small as crab traps and even bicycles.

The Pilot Project was intended from the beginning to examine actual oil and gas development projects where MMS had invoked an avoidance mitigation. Avoidance mitigations are used to protect biological and archaeological features on the sea floor. By directing industry to avoid these features, the impact of the project on the environment is "mitigated," that is to say, lessened or eliminated. Our task, then, was to examine several construction projects where industry had been directed to avoid effecting biological and archaeological features and see if they, in fact, had done so. We were determined to look at each of the major kinds of features that MMS protects by stipulation or regulation. This will include the Pinnacle Trend in Main Pass, Sonnier Bank in Vermilion 305, and a possible shipwreck in High Island 108.

The first features to be examined were the Pinnacle Trend in Main Pass and Viosca Knoll. The Pinnacle Trend is a region of low-relief rocky areas and major carbonate pinnacles at the outer edge of the Mississippi-Alabama Shelf between the Mississippi River and the De Soto Canyon. These hard-bottom features provide a large surface area for the growth of sessile invertebrates and attract large numbers of fish. Mr. Tom Yourk, the marine biologist on the team, presents our findings in the Pinnacle Trend during the next presentation.

Another important biological feature that enjoys MMS protection is the topographic highs formed by sedimentary rocks pushed above the surrounding sea floor by salt domes in the Central Gulf. These features form offshore banks such as the Flower Gardens and Stetson Bank, which are now designated as National Marine Sanctuaries, as well as 18 other banks. One of the most significant of these is Sonnier Bank, where the MMS Scientific Dive Team has spent two seasons gathering important data to characterize this resource. Mr. Terry Dempre, staff geophysicist, will describe the results of the 1997 survey in this session.

Since we are based in New Orleans and firmly grounded in the philosophical concept of *lagniappe*, we also were happy to jump on an opportunity to join a joint NOAA/MMS sponsored expedition to the Flower Gardens National Marine Sanctuary.

Although this investigation was not part of our original proposal to management, it gave us an opportunity to test the equipment over an extremely rough and irregular bottom, in this case, to see if we could use the side-scan to detect damage to the coral. We found that it was very difficult to distinguish impacts to the coral. On the other hand, the side-scan is very useful for mapping the morphology of the Bank. NOAA biologists were particularly interested in being able to accurately map these sand flats, which could address questions about the formation and development of the Flower Gardens.

Another major concern of MMS is the protection of archaeological resources, particularly historic shipwrecks. Before any well is drilled or pipeline is laid, industry is required to conduct their own remote sensing survey of the lease block to locate potential archaeological resources. These are likely to be reported to us only as small areas of anomalous magnetic disturbances or unidentified side-scan sonar targets that may be indicative of a shipwreck. Since we usually don't know from these data whether it's a historic shipwreck or not, industry is asked to either dive on the site and identify it, or avoid it. Usually they opt to avoid the area. This year's test project looked at just such an area in High Island to see how well industry did in avoiding these features. Dr. Rik Anuskiewicz, MMS senior staff marine archaeologist, reports on these findings.

A number of other opportunities arose to use the side-scan equipment to expand our knowledge of historic resources in the Gulf of Mexico. Returning to Biloxi following the Pinnacle survey, we documented a historic steamship off Horn Island, Mississippi (Figure 1E.1). This wreck was unknown to the Mississippi state archaeologist although under the Historic Shipwreck Protection Act, it is state property. We were able to provide them with exact coordinates and detailed images of the wreck.

The side-scan also was extremely useful in documenting a previously unknown wreck in High Island Area, the *New York*, which sank in a storm in 1846. The discovery of this wreck, which our records had indicated was in the Vermilion area, allowed us to release 9 block from the 50-meter survey requirement, resulting in a savings to operators of nearly \$400,000.

An interesting feature of the wreck is its steam engine, a rare crosshead type. Ironically, this block had been surveyed by industry using a 100 kHz sonar and no evidence of the shipwreck was found.

Another potential use for MMS' side-scan sonar is to assist the Field Operations Section in verifying compliance with site clean-up and operational issues. During the 1997 season we investigated sub-sea connections in the Grand Isle area and structure removals in West Delta 33 and West Delta 42.

The FY97 pilot project accomplished even more than was originally planned. Side-scan images were collected in several pipeline construction areas within the biologically-stipulated Pinnacle Trend Area offshore of Mississippi and Alabama. Also side-scan data was collected on protected biological

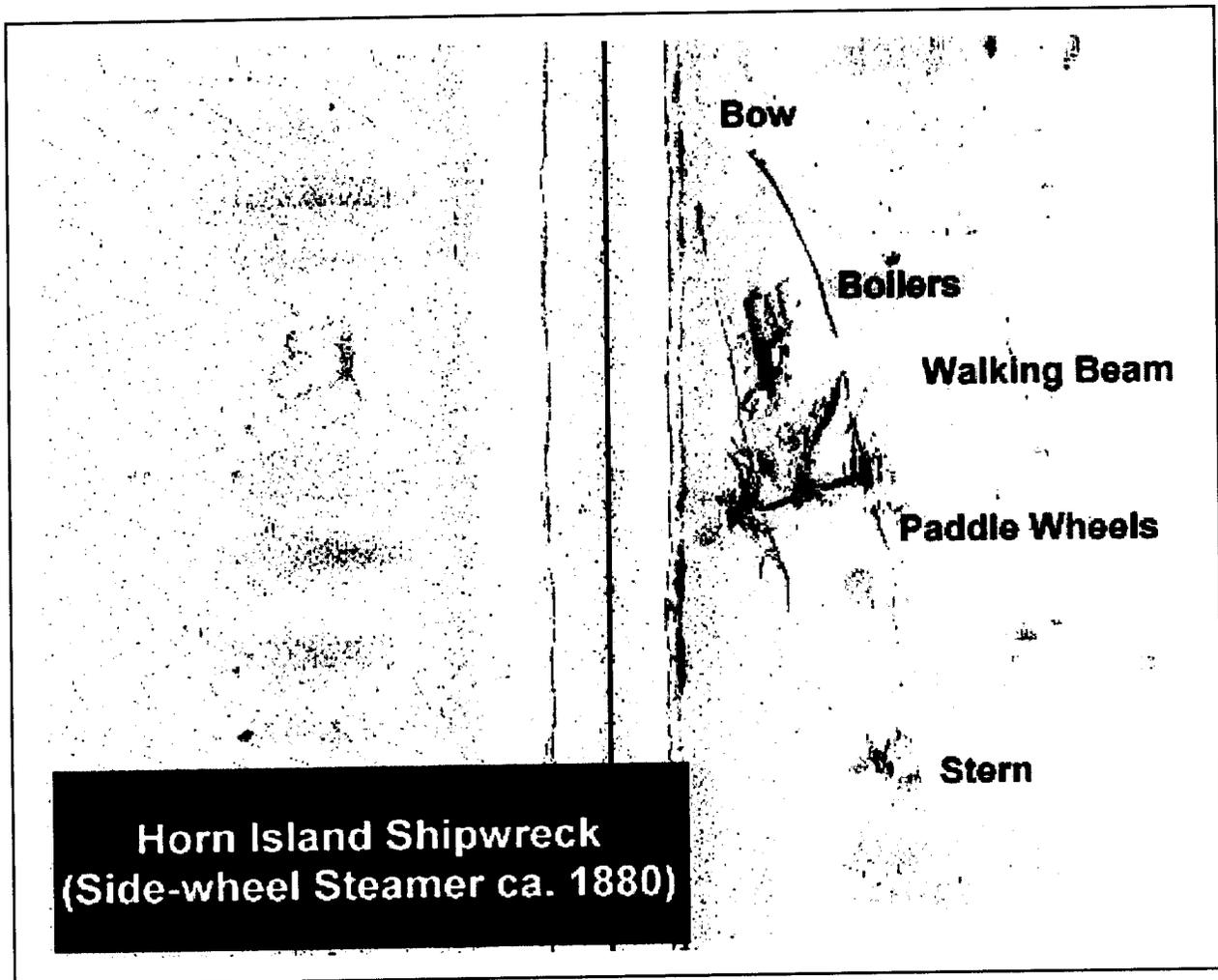


Figure 1E.1. Side-scan image of a historic steamship off Horn Island, Mississippi.

topographic features at Stetson and Sonnier banks, and at the Flower Gardens banks. Although the MMS pilot project observed some evidence of seafloor damage to protected biological features, in most cases it appeared that the oil and gas industry had complied with MMS recommended avoidance measures. Submerged archaeological features also were documented using the high resolution side-scan sonar system. A historic side-wheel steamer with an intact “walking beam” engine was documented off the coast of Mississippi. Another steamer, the *New York* (wrecked 1846), which was one of the first vessels to trade with the Republic of Texas, was investigated in an active lease block approximately 50 miles southeast of Galveston, Texas. This work was instrumental in establishing appropriate protective measures for these two significant historic sites with respect to oil and gas exploration and development.

In addition to fulfilling the needs of the MMS, the Seafloor Monitoring Pilot Project has provided an opportunity to form cooperative research partnerships with other agencies and institutions to achieve common research goals. Several monitoring projects were joint, cost sharing ventures with other state, federal, and private organizations, including NOAA, Texas A&M University, the New

Orleans Aquarium of the Americas, and the State of Florida, Bureau of Archaeological Research. Based on the success of the first year of the Seafloor Monitoring Project the MMS GOMR has been funded another year to continue their monitoring efforts. The FY98 monitoring studies and forthcoming recommendations by the MMS GOMR, will help to develop offshore mineral resources in an environmentally sound manner.

Dr. Jack B. Irion joined the Minerals Management Service, U.S. Department of the Interior, in August 1995, with the title of Marine Archaeologist. Prior to joining the MMS, Dr. Irion served as Vice President for Nautical Archaeological Services with the consulting firm of R. Christopher Goodwin & Associates, Inc., in New Orleans, Louisiana. For over 15 years, Dr. Irion provided archaeological consulting services to the Baltimore, Charleston, Mobile, New Orleans, Pittsburgh, Philadelphia, Savannah, Vicksburg, and Wilmington Districts of the Corps of Engineers, as well as to the Maryland Port Administration, and the State of Tennessee. Dr. Irion received his B.A. (1974) and M.A. (1977) in Archaeological Studies from The University of Texas at Austin. He was awarded his Ph.D. from the Institute of Latin American Studies of the University of Texas in 1991. During his career, Dr. Irion has specialized in conducting remote sensing surveys for shipwrecks, which succeeded in locating such historically significant vessels as the C.S.S. *Louisiana*, the sailing barque *Maxwell*, and the steamboats *Princess*, and *Kentucky*. In addition, he has directed numerous diving investigations on historic shipwrecks, including the steamship *Columbus* and the Civil War gunboats *Tawah* and *Key West*. Most recently, he has participated in MMS investigations of the Civil War vessel U.S.S. *Hatteras* and the steam packet *New York*.

MONITORING SEA FLOOR DAMAGE IN THE PINNACLE TREND MAIN PASS AREA

Mr. Tom Yourk
Minerals Management Service
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INTRODUCTION

The MMS is charged with leasing offshore tracts to industry for oil and gas exploration and development. This responsibility is accompanied by a mandate to minimize environmental impacts associated with these activities and to protect areas of significant environmental importance. Environmental protection is accomplished with the imposition of a variety of lease stipulations, mitigations, advisories, and reminders. These measures usually require site specific conditions, such as avoidance of specific features or other requirements.

ARCHAEOLOGY AND THE GULF OF MEXICO REGION SEA FLOOR MONITORING PROGRAM

Dr. Richard J. Anuskiewicz
Minerals Management Service
Gulf of Mexico OCS Region

MONITORING ARCHAEOLOGICAL RESOURCES ON THE OCS THROUGH LEGISLATIVE MANDATES

The Federal Government has had a long legislative history of formulating laws and statutes to evaluate and protect, where appropriate, significant archaeological resources. As a part of this legislative history, monitoring became, and still is, the only method of checks and balances used to review and evaluate impacts to archaeological resources as a result of the Federal permitting process. Three major statutes and laws have contributed to Federal management of archaeological resources. They include the Antiquities Act of 1906, the Historic Site Act of 1935, and the National Historic Preservation Act of 1966, as amended (US DOI NPS CRP 1990, Carnett 1991). The Antiquities Act initiated archaeological site protection by specifying protection of antiquities on lands owned or controlled by the Federal Government. The Historic Site Act declared a Federal policy to preserve historic and prehistoric resources. Perhaps the most appropriate piece of Federal legislation directly related to oil and gas development in the Gulf of Mexico is the National Historic Preservation Act. This legislation states that the Agency official with jurisdiction over a Federal undertaking has legal responsibility to identify and evaluate affected archaeological properties and assess an undertaking's effect upon them. In the MMS, each Regional Director is the Agency official doing the permitting to the oil and gas industry, and, therefore, has the legal responsibility of designating and protecting archaeological resources.

RECOGNIZING POTENTIAL ARCHAEOLOGICAL RESOURCES ON THE SEA FLOOR

As Dr. Irion and Mr. Yourk pointed out in an earlier paper on the MMS Gulf of Mexico Region's (GOMR) monitoring program's new high-resolution side-scan sonar, technology can be used as an effective means to monitor impacts to the ocean floor. The MMS GOMR archaeological resource management program focuses on evaluating potential impacts to either prehistoric or historic resources on the seafloor. This is accomplished through reviewing geophysical reports for lease block and pipeline corridor surveys submitted to the MMS by the oil and gas industry. Submerged archaeological resources on the OCS fall into two basic categories: they are either prehistoric or historic features on or near the surface of the seafloor.

Potential prehistoric archaeological resources are more difficult to locate and identify than historic ones. Prehistoric resources are represented by former geologic land forms located on or buried just below the seafloor in shallow sediment. These features, such as natural levees, river and stream terraces, shell midden concentrations, and sinkholes, can be recorded and identified by surveying with shallow-penetrating seismic instrumentation. Potentially important prehistoric geologic features

can be identified by examining examples of subbottom profile data presented in archaeological and hazards survey reports submitted to the MMS by the oil and gas industry.

Historic archaeological resources, on the other hand, can be easier to identify because they usually are represented by a physical or tangible object on the seafloor such as the physical remains of a shipwreck. Shipwrecks lying on the sea floor can be accurately located, recorded, and mapped by using side-scan sonar imagery in consort with a magnetometer survey and Differential Global Positioning System navigation. The remains of shipwrecks buried in the shallow sediment are, of course, another potential problem. The MMS, however, takes a reasonable approach in managing these potential buried wreck sites on the OCS by specifically looking at the recommendations of the contract archaeologist and his analysis of avoidance of unidentified magnetic anomaly clusters recorded during lease block and pipeline surveys. From these recommendations, the MMS staff archaeologist reviews the report and determines the appropriate avoidance mitigations for plans and pipeline requesters as a condition of their construction permit.

POTENTIAL IMPACTS TO ARCHAEOLOGICAL RESOURCES ON THE OCS

There are three basic probable scenarios as to how archaeological resources can be physically impacted or disturbed on the OCS sea floor. They include commercial fishery trawling, private or commercial vessel anchoring, and seafloor construction activities associated with oil and gas exploration and development.

Anyone who has been on a Louisiana beach during shrimping season can attest to the systematic trawling pattern by hundreds of shrimp boats in their quest for shrimp offshore. One could venture to guess that just about every square foot of the Louisiana seafloor, out to the OCS Shelf Break, has had a shrimp trawl dragged across it. Trawling scars are relatively shallow and tend to smooth out the bottom and move sea floor debris around. This impact to the seafloor is real, on going, and continuing. Moving around of seafloor debris causes problems with resource evaluation (Irion and Bond 1988:88; Anuskiewicz and Irion 1995).

Another impact to the seafloor could come from commercial and private vessels anchoring overnight or waiting out a storm. We estimate that this type of impact probably has taken place at irregular intervals to some extent throughout the Gulf. The amount, shapes and depths of anchor scars from these vessels would vary depending upon vessel size, anchor weight, and water depth. What's important here is that we believe that these anchor scars do occur, but with a lot less frequency than those resulting from shrimping trawls and oil-and gas-related seafloor impacts.

The third and very plausible scenario of seafloor impact is caused by construction activities associated with oil and gas exploration and development. These potential seafloor impacts are the focus of the remainder of this presentation. The GOMR archaeological resource management program has always been concerned about oil and gas industry related impacts to potential archaeological resources on the seafloor. However, until now we did not have the budget, technology, and human resources support to develop a viable monitoring program (Irion and

Anuskiewicz 1997a). With all these support elements now available, we have completed our first successful year of seafloor monitoring.

Prior to going out and conducting archaeological monitoring we developed a strategy based on some basic questions. What type of damage would we expect to find as a result of oil and gas activities? What is the actual site or impact formation process (Anuskiewicz 1989:78)? In our research of these issues we learned that, generally, seafloor impacts by oil-and gas-related activities are caused by the placement of an exploratory jack-up rig, placement of a permanent production platforms, and cutting of a 1-meter trench in the seafloor to bury a pipeline. The jack-up rig placement causes the least amount damage to the ocean bottom because after the rig is floated in three legs are lowered in place. However, pipeline trenching and permanent platform placement cause the most seafloor impacts because of the use of anchor barges during the construction process.

With some idea of what to look for on the seafloor and management support of our program ideas, we looked towards the state of technology-transfer for our sea floor monitoring. During the development of a formal monitoring strategy for archaeological resources, GOMR staff archaeologists researched and field tested the available 600-kHz side-scan-sonar technology (Irion and Anuskiewicz 1997 b and c). In an earlier presentation, Dr. Irion discussed the imagery technology in detail and, frankly, we admit we were impressed at the image detail, resolution, instrument deployment, digital data gathering capabilities, and total cost.

To field test this new side-scan system's archaeological capability, we conducted a survey over a known 19th-century side-wheel steamboat wreck located off Horn Island, Mississippi. We feel this is an excellent example of the capabilities of this side-scan technology. From the 75-meter scale we clearly saw the outline of the iron hull, the bow and stern, paddle wheels, and steam engine components. The 25-meter scale view showed a lot more detail, including paddle wheel shafts and eccentrics, the walking beam, some engine parts, and the two boilers.

Applying this new side-scan technology to the archaeological resource management program was not too difficult. These potential resources either were or were not impacted. Our measurement tool was the high resolution side-scan imagery of the seafloor in areas where oil and gas activities occurred.

One of our archaeological monitoring projects involved side-scanning the remains of a 19th-century side-wheel steam vessel the *New York*, which sank during a hurricane in 1846. It is located in the High Island Area (Munson, Avery per. comm. 1997) about 82 kilometers offshore Texas. Historical records indicated the vessel broke up during the sinking. The remains of this vessel are protected by legislative mandates because these remains meet eligibility requirements for listing in the National Register of Historic Places. To provide reasonable protection from impacts that may be caused by oil and gas exploration and development, the MMS needed to determine the extent of the debris field associated with the shipwreck. This was accomplished by conducting a close-interval marine magnetometer and side-scan survey. Once this was completed, a reasonable set of avoidance mitigation criteria was developed so that oil and gas development in this block could continue and not impact this significant historic resource.

Our final example was an attempt to monitor lay barge anchor patterns associated with the construction of a pipeline. We knew that there were multiple anchoring positions needed to trench and physically construct a pipeline. However, what we didn't realize was the sheer number of anchor placements associated with this type of seafloor construction. Our test case example involved the installation of a 5,800-foot pipeline. We counted at least 124 anchoring positions used to construct a pipeline a little over one mile long. The lease block contract archaeologist recommended avoidance of three clusters of magnetic anomalies and an area of channel margins suggestive of prehistoric site potential. From the map submitted we can see that the lay barge anchor position did avoid the magnetic anomalies. However, the operators did not manage to avoid the channel margins recommended for avoidance.

CONCLUSION

The first year of using a high resolution side-scan-sonar system, as a management tool for the archaeological resource management program was extremely successful. This system provides an easy-to-operate, cost-effective method to answer some basic questions when it comes to determining if an impact has occurred to the seafloor and to a potential archaeological resource. It's as easy as "yes" or "no" in most cases. Further, this instrument provides an accurate and effective means to evaluate historic resources on seafloor, as can be seen through the MMS evaluation of 1847 side-wheel steam ship. Year Two of this program will provide another field season and opportunity to gather more reliable information and better prepare the MMS archaeological resource program managers to make better resource management recommendations, and ultimately, better higher level management decisions.

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Rik Anuskiewicz was awarded his B.A. in 1972 and his M.A. in 1974 in Anthropology, with specialization in archaeology from California State University at Hayward. Rik was employed with the U.S. Army Corps of Engineer Districts of San Francisco, Savannah, and New England Division from 1974 to 1984, as a terrestrial and underwater archaeologist. In 1980 he began work on his doctorate. In 1984 he accepted his present position with Department of the Interior, Minerals Management Service, Gulf of Mexico Region as a marine archaeologist. Rik received his Ph.D. in 1989 in Anthropology, with specialization in marine remote-sensing and archaeology from the University of Tennessee at Knoxville. Rik's current research interest is focused on using remote-sensing instrumentation as a tool for middle-range theory building through the correlation of instrumental signatures to specific observable archaeological indices.

REFINING THE HIGH PROBABILITY SHIPWRECK MODEL IN THE GOMR

Dr. Jack B. Irion
Minerals Management Service
Gulf of Mexico OCS Region

Part of the mission of the MMS is to ensure that significant archaeological sites are not adversely affected by oil and gas exploration and development. This responsibility often includes the protection of historic shipwrecks. Historical research conducted for MMS Studies 89-0023, 24, and 25 indicates that over 400 ships have sunk on the federal OCS dating from 1625 to 1947; thousands more have sunk closer to shore in state waters during the same period. Only a handful of these has been

scientifically excavated by archaeologists for the benefit of generations to come. In several cases, the MMS has partnered with state and federal agencies conducting this research. The work conducted by the MMS and other scientists in the Gulf of Mexico contributes to our understanding of how our nation developed by studying the technology that fostered the growth of the United States.

For several millennia, ships were the most sophisticated machines on earth. They have shaped history by expanding trade and waging war, spreading ideas (and sometimes plague), and discovering and colonizing new lands. At the same time, the crews of these ships lived in closed societies, with traditions, beliefs, vocabularies, and hierarchies that set them apart from those on shore. When one of these ships met with disaster at sea or sank as a result of war, its remains literally became a time capsule, preserving clues to the story of our past. When archaeologists scientifically excavate a shipwreck under water, they read these clues to form a picture of what it was like to live on a ship that sank hundreds of years ago. In that sense, shipwrecks are special archaeological sites because, unlike sites on land, everything on board was in use during a single moment in time. Because of this, the study of shipwreck sites has contributed to the understanding of broader issues of human history, and helps us to understand better who we are by telling us where we have been. The MMS has taken part in the study of some of the most historically significant shipwrecks in the Gulf.

A SEVENTEENTH CENTURY WRECK: LA SALLE'S *BELLE*

One of the most significant underwater archaeological finds in North America was made by a team from the Texas Historical Commission (THC) in 1992 in 12 feet of water in Matagorda Bay. After the team recovered a distinctive bronze cannon more than six feet long, weighing some 700 pounds and bearing the crest of Louis XIV, they hypothesized that the vessel was the French ship *Belle*. The *Belle* was the smallest of four ships sailed by French explorer René Robert Cavelier de La Salle in his ill-fated search for the mouth of the Mississippi River in 1684. The team also recovered pewter plates, lead shot, several complete pottery vessels, a stoneware pitcher, a sword hilt, a brass buckle, bells, straight pins, glass trade beads, and an iron pike with remnants of a wooden handle. The artifacts are well preserved, having been covered in the sand and mud of Matagorda Bay. Scientists from the MMS were invited to participate in this important project during the excavation and gained insight into how wrecks of a similar age might appear in federal waters. Analysis of the magnetic signature of this wreck will provide the MMS with valuable comparative data for the review and analysis of shallow hazard and archaeological survey reports.

Archaeological excavation of the wreck site began in 1996. Because conditions under the murky waters of Matagorda Bay were so poor, the THC undertook construction of a steel cofferdam around the site at a cost of over \$1 million. After the water was pumped out of the 148-foot by 118-foot enclosure, the wreck could be excavated as if on dry land.

Although an expensive procedure, the effort proved worthwhile and permitted the recovery of extraordinarily fragile objects such as coils of rope, items of clothing, and a wooden gun carriage. The remains of a French sailor were even found preserved in the bow section. Using the skull to reconstruct the face, scientists have re-created the appearance of one of La Salle's crew who lost his life on the Texas shore 313 years ago.

The vessel's mission included the establishment of a colony at the mouth of the Mississippi and trade with the Indians. The excavated hull contained ample evidence of the latter in the form of thousands of tiny glass beads and beautifully crafted hawk's bells. Other finds included crated muskets, two more bronze cannon for use in the intended fort, tools, and pewter dinnerware. One of the most historically valuable artifacts, however, is the hull of the ship itself. The *Belle* is the oldest French colonial shipwreck found in the New World, and represents a transition period in naval architecture. Study of the hull will provide information on the undocumented shift from ancient to modern methods of shipbuilding. Artifacts, including the hull, will be conserved at Texas A&M University.

AN EIGHTEENTH CENTURY SITE OFF LOUISIANA

An eighteenth century site was discovered off the Chandeleur Islands, east of the Mississippi River delta. The site was investigated by Texas A&M University published under MMS Report 89-0092. A ballast pile, pottery shards, a lead patch, a lead bilge pump tube, and six iron cannon were recorded during the investigation. No hull remains were found at the site and researchers concluded that the site represented the location of an accidental grounding and discard of unnecessary ballast and ordnance to lighten the ship. This hypothesis was supported by the fact that all six cannon were damaged in some way and, while useless as ordnance, could have functioned as ballast. Interestingly, three of the cannon were of Swedish manufacture and were cast between 1771 and 1784.

NINETEENTH CENTURY SHIPWRECKS

Over 70 vessels are believed to have wrecked on the OCS between the beginning of the nineteenth century and start of the Civil War in 1861. One of the most historically significant of these is the wreck of the *New York*, a side-wheel steamship engaged in trade between Galveston, New Orleans, and New York from 1839 to her loss in 1846. The wreck site was recently discovered by private citizens who are cooperating fully with the MMS to preserve the site's archaeological information and to ensure that it is not impacted by future oil and gas development. The MMS is taking an active role in encouraging divers to preserve and record the historical and archaeological data contained in wrecks on the federal OCS. In this way, the interests of the salvors, sport divers and the American people can be protected.

THE CIVIL WAR (1861-1865)

The Civil War in the Gulf is defined by the Northern strategy of the blockade of Southern ports and the daring attempts by Confederate vessels to run this blockade. A number of important Civil War vessels have been located in state waters, such as the Confederate ironclads CSS *Louisiana* in Plaquemines Parish, Louisiana, and the *Huntsville* and *Tuscaloosa* in the Mobile River. The remains of the Union ironclad *Tecumseh*, whose sinking by a Confederate mine prompted Farragut's famous order "Damn the torpedoes, full speed ahead!" are well known off Fort Morgan, Alabama. Only one U.S. warship, however, was sunk at sea in the Gulf. This important shipwreck, the USS *Hatteras*, has been the subject of repeated investigations by the MMS, the Texas Historical Commission, and Texas A&M University at Galveston.

The USS *Hatteras* was a side-wheel steamer acquired by the Navy in 1861 and armed with four 32-pounder cannon (a 20-pounder rifled cannon was added later). After distinguished service in the South Atlantic Blockading Squadron, the vessel was transferred to the Gulf Blockading Squadron on 26 January 1862. In less than a year, the *Hatteras* captured seven Confederate blockade runners off Vermilion Bay, Louisiana. Early in 1863, she was ordered to join the squadron under Rear Admiral David Farragut, who was attempting to retake the key Texas port of Galveston.

As the blockading squadron lay off the coast on the afternoon of 11 January 1863, a set of sails was sighted just over the horizon, and the *Hatteras* was ordered to give pursuit. She chased the intruder for four hours, closer and closer into shore, and farther and farther from her supporting fleet. Finally, as dusk was falling, the *Hatteras* came within hailing distance of the square-rigged, black-hulled vessel. Commander Homer C. Blake demanded to know the identity of the ship. “Her Britannic Majesty’s Ship *Vixen*,” came the reply. Blake ordered one of *Hatteras*’ boats launched to inspect the “Britisher.” Almost as soon as the boat was piped away, a new reply came from the mystery ship, “We are the CSS *Alabama*!” A broadside from the Alabama’s guns punctuated the reply. Within 13 minutes, the *Hatteras*, sinking rapidly, surrendered.

The *Hatteras* today rests in 58 feet of water about 20 miles off Galveston. Her 210-foot long iron hull is completely buried under about three feet of sand. Only the remains of her 500-horsepower walking beam steam engine and her two iron paddle wheels remain exposed above the sea floor. Since the site’s discovery in the 1970s, MMS has engaged in periodic monitoring of the wreck to ensure that it is not damaged by surrounding oil and gas lease development. Although the wreck remains the property of the U.S. Navy, MMS has joined forces with the THC and Texas A&M at Galveston to preserve this important archaeological treasure for posterity. The wreck of the USS *Hatteras* is an integral part of the story of the Civil War on the Texas coast, the defense of which is regarded as one of the greatest military feats of the Confederacy. The ship’s dramatic history, along with the fact that the remains of the vessel are virtually intact, make it one of the most important underwater archaeological sites in the United States.

THE TWENTIETH CENTURY - SHIPWRECKS FROM WORLD WAR II

Federal law defines an historic site as being at least 50 years old. As a result, wrecks associated with World War II now meet that criterion. Nearly all the shipwrecks in the Gulf from that period relate to one cause—attack by the German submarines known as “U-boats.” U-boat comes from the German word “Unterseeboot.”

During the years 1942 and 1943, a fleet of over 20 German U-boats cruised the Gulf, seeking to disrupt the vital flow of oil carried by tankers from ports in Texas and Louisiana. They succeeded in sending 56 vessels to the bottom; 39 of these are now believed to be in state or federal waters off Texas, Louisiana, and Florida. After their initial, devastating success, U-boat attacks in the Gulf became rare by the end of 1943, after merchant vessels began cruising in armed convoys. The opening of the “Big Inch” pipeline from Texas to New Jersey also contributed to freeing the war effort from relying on ships to transport crude oil.

As a result of remote-sensing surveys required of the oil and gas industry by the MMS, several U-boat casualties have been located on the sea floor. These include the *Heredia*, a United Fruit Company freighter; the oil tanker *Sheherezade*; the *Gulfpenn*, which carried 90,000 barrels of fuel oil; and the *Robert E. Lee*, a passenger freighter sunk by the U-166. The U-166 was the only German U-boat sunk in the Gulf, ostensibly by an American torpedo plane 20 miles off the coast of Louisiana. Its exact whereabouts still remain a mystery that will, perhaps, one day be solved through the cooperative partnership of government and industry to protect and preserve our history beneath the sea.

As a result of industry surveys, over 80 shipwrecks have been identified in the Gulf of Mexico. Many of these are modern wrecks—supply boats, crewboats, shrimpers, etc. Most remain unidentified because industry generally elects to avoid a potential historic shipwreck rather than determine if it is, or is not, historic.

However, MMS' high probability model is based on the probable presence of an historic wreck in an individual block based on historic records. Because historic records are inherently inaccurate, if a wreck was found reported at a particular location, then not only that block, but also the eight blocks around it are designated as historic high probability block. This means that industry is required to survey the block using side-scan sonar, magnetometers, and sub-bottom profilers at a 50-meter lane spacing, as opposed to the normal 300-meter spacing required for hazard surveys. This translates into additional time and somewhere around an additional \$40,000 in survey cost for each block.

With the discovery and documentation of some of the historic wrecks that trigger the 50-meter designation, we are able to revise the list of historic blocks and provide some relief to industry in the form of reduced survey costs. This year alone, we have released lease blocks in Galveston, South Timbalier, and Vermilion areas because of the documented discoveries of the *Hatteras*, the *La Belle*, and the *New York*. This action has resulted in a savings to industry of nearly one half million dollars. As we continue to locate and identify shipwrecks in the Gulf, we will continue to release other blocks from the 50-meter survey requirement.

Unfortunately, as more and more areas are surveyed, we are also finding that our historic block designations are not quite as accurate as one would hope. There are many reasons for this: in the days before satellites when positioning was reckoned using astrolabes, sextants, and chronometers, an accuracy of five miles was considered outstanding. Under conditions of storms, hurricanes, or warfare, accurate reckoning of position at the point at which your ship was sinking beneath you was unlikely. Secondly, reporting of wreck positions depended upon survivors accurately reporting their tale. More often than not, wrecks are reported as occurring simply "between Galveston and New Orleans" or "about 50 miles southwest of Galveston." Even relatively recent wrecks from World War II are not accurately reported. Both the *Robert E. Lee*, a 1,632-ton passenger ship sunk 1 August 1942, by the U-166 and the *Gulf Penn*, an 8,862-ton freighter sunk in May of the same year, were found west of the high probability blocks in Mississippi Canyon thought to contain them. Side-scan has located three wrecks believed to be the *Heredia*, the *R.W. Gallagher*, the *Hamlet* in Ship Shoal Area, all far to the south of where their historically recorded positions placed them. More importantly, the 1846 wreck of the steamship *New York*, an historic site eligible for inclusion in the

National Register of Historic Places and one of the most important shipwreck sites in the Gulf, not only lay outside the high probability areas, but failed to be recognized by an oil company survey at 150-meter survey interval. It has become obvious, at least to the archaeologists at MMS, that the high probability area model is in sore need of revision now that it has been in effect for some 10 years. We are attacking this problem in two ways. First, we will be working with students at the University of New Orleans to conduct more in depth historical research, which we hope will provide us with better locational information. Secondly, we propose to investigate reported shipwrecks during the sea floor monitoring investigations using high resolution side-scan sonar and the MMS Scientific Dive Team. These investigations should help to positively identify more wrecks. Our underlying philosophy is that the more that is known about the location of historic shipwrecks on the sea floor, the less restrictive we have to be to industry in order to fulfill our obligation to safeguard our archaeological resources beneath the sea.

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Dr. Jack B. Irion joined the Minerals Management Service, U.S. Department of the Interior, in August 1995, with the title of Marine Archaeologist. Prior to joining the MMS, Dr. Irion served as Vice President for Nautical Archaeological Services with the consulting firm of R. Christopher Goodwin & Associates, Inc., in New Orleans, Louisiana. For over 15 years, Dr. Irion provided archaeological consulting services to the Baltimore, Charleston, Mobile, New Orleans, Pittsburgh, Philadelphia, Savannah, Vicksburg, and Wilmington Districts of the Corps of Engineers, as well as to the Maryland Port Administration, and the State of Tennessee. Dr. Irion received his B.A. (1974) and M.A. (1977) in Archaeological Studies from The University of Texas at Austin. He was awarded his Ph.D. from the Institute of Latin American Studies of the University of Texas in 1991. During his career, Dr. Irion has specialized in conducting remote sensing surveys for shipwrecks, which succeeded in locating such historically significant vessels as the C.S.S. *Louisiana*, the sailing barque *Maxwell*, and the steamboats *Princess*, and *Kentucky*. In addition, he has directed numerous diving investigations on historic shipwrecks, including the steamship *Columbus* and the Civil War gunboats *Tawah* and *Key West*. Most recently, he has participated in MMS investigations of the Civil War vessel U.S.S. *Hatteras* and the steam packet *New York*.

ROLE OF THE GULF OF MEXICO OCS REGION'S SCIENTIFIC DIVING TEAM IN SEAFLOOR MONITORING

Mr. Les Dauterive
Minerals Management Service
Gulf of Mexico OCS Region

Following its creation in 1982, the Minerals Management Service (MMS) made one of its highest priorities to establish public confidence in the offshore program by using good science in decision making. After the MMS was charged to permit offshore oil and gas development in an environmentally sound manner, it became necessary to know more about the environment it was protecting. Since that environment lies within the sea, the most efficient and cost-effective means of accomplishing that goal sometimes has been for MMS scientists to jump off a boat with a tank of compressed air on their backs and see for themselves. For over 20 years, the MMS Gulf of Mexico Region (GOMR) diver scientist have been doing just that, with the results that inter-agency conflicts have been resolved, significant biological features have been protected, safety issues have been reported and corrected, historic shipwrecks have been discovered, controversies have been averted, and seafloor impacts have been discovered.

The MMS GOMR dive team is comprised of a group of hard-working, dedicated diver scientist who strive to provide the Region with scientific information through underwater observation, photo and video documentation, and other forms of data-gathering supportive of the MMS mission. The scientific dive team consists of marine archaeologists, marine fisheries biologist, a coral reef ecologist, an environmental scientist, geographer, and geophysicist.