BOEMRE OCEAN SCIENCE

Special Edition
THE *DEEPWATER HORIZON* RESPONSE
DECEMBER 2010

THE SCIENCE & TECHNOLOGY JOURNAL OF THE
BUREAU OF OCEAN ENERGY MANAGEMENT,
REGULATION AND ENFORCEMENT

DECEMBER 2010

Special Edition

BOEMRE *OCEAN SCIENCE* is published quarterly by the Bureau of Ocean Energy Management, Regulation and Enforcement to communicate recent ocean science and technological information and issues of interest related to offshore energy recovery and ocean stewardship.

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ON THE COVER

Top left: An orange brisingid basket star on the large *Lophelia pertusa* reef at 1,475 ft. (450 m) depth in Viosca Knoll Block 826. At the top of the image is a school of Beryx fish swimming over the top of the reef. *Photo courtesy of NOAA.*

Top right: A NMFS research vessel approaches cetaceans in the Gulf during the 2010 Sperm Whale Prey Cruise.

Bottom: Researchers in the control room aboard R/V *Ronald H. Brown* check the position and status of deployed sediment traps. *Photo courtesy of MarkSchrope.com/*Lophelia *II 2010 Expedition, NOAA-OER/BOEMRE.*

All photos courtesy of Bureau of Ocean Energy Management, Regulation and Enforcement unless otherwise noted.

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Michael R. Bromwich, *Director*

Director's Note

As we continue to learn lessons from the *Deepwater Horizon* blowout and spill, the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) is implementing a number of regulatory reform initiatives that will set high standards for offshore energy development. This emphasizes the central role played by our science programs, because the decisions we are making must be informed by scientific research.

With an annual budget of about $30 million devoted to environmental research, BOEMRE is a leading contributor to the body of scientific knowledge regarding the marine environment off the nation's coasts. BOEMRE scientists and engineers evaluate data to determine the location of resources, technologies used in the recovery of resources, safety measures to prevent accidents and spills, and most importantly, potential effects of offshore activities on the marine environment.

Science is at the core of the decisions we make at BOEMRE and we are proud of the science this bureau does. As you read through the following pages, you will learn more about our complex mission and the important work we are doing—in partnership with the nation's leading scientists—to promote safer, environmentally-responsible offshore energy development.

Michael R. Bromwich, Director

About This Issue

The Federal Government's response to the *Deepwater Horizon* blowout and resulting oil spill underscored the critical importance of sound scientific information in the decision-making process.

This special edition of *BOEMRE Ocean Science* highlights several completed and ongoing studies that contribute significantly to spill response and recovery. These studies were conducted and funded by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) in partnership with State and other Federal agencies, academic institutions, and the private sector to better understand the environment and communities of the Gulf of Mexico.

BOEMRE Ocean Science is the bureau's science and technology journal. Each quarterly issue highlights the work of BOEMRE scientists and engineers and BOEMRE-funded studies in the Alaska, Gulf of Mexico, and Pacific regions and the Atlantic area. These studies inform policy decisions regarding offshore energy development and contribute greatly to the body of knowledge about our coastal and marine environments.

Editor's Note: On June 18, 2010, Secretary of the Interior Ken Salazar signed a Secretarial Order formally changing the name of the Minerals Management Service to the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). This journal uses the acronym BOEMRE to refer to the bureau.

A Unity of Effort at the Unified Area Command Center

From the first days of the *Deepwater Horizon* oil spill, science staff from the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Gulf of Mexico OCS Region focused their expertise, knowledge, and resources on collaborative problem solving with other agencies and groups, offering sound scientific guidance to battle the spill.

The spill was literally in our backyard.

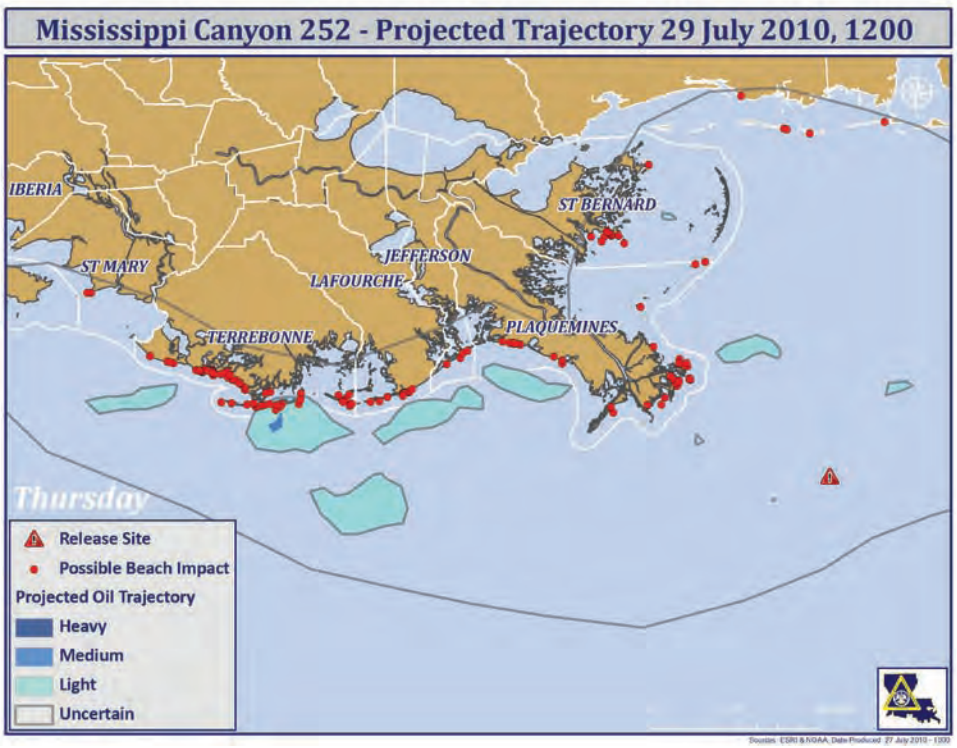
Set up in the first days of the spill, the Unified Area Command (UAC) center was—and remains—the hub of the incident response. At the UAC, scientists and specialists from many agencies and universities, from BP and the Gulf States worked around the clock responding to the spill.

The BOEMRE scientists, liaisons for the UAC's Environmental Unit, provided U.S. Coast Guard Rear Admirals Mary Landry, James Watson, and Paul Zukunft, who were the rotating Federal On-Scene Coordinators, with the best scientific guidance for attacking the spill. We gave advice and information about overflights needed for monitoring and potential impacts of in situ burns. Our scientists' information was immediately used for a subsea monitoring program to find the boundaries of the spill. The UAC also coordinated with the National Incident Command (NIC) center in Washington, DC on response activities and worked with other Federal agency partners.

Scientific information and expertise from BOEMRE-funded studies were indispensible for the spill response. For example, our protected species biologists worked with the National Park Service on comprehensive wildlife management planning. Information from our marine mammal studies helped predict the locations, depths, and possible movements of endangered sperm whales. Our oceanographers provided the National Oceanic and Atmospheric Administration with data that they used for oil trajectory and shoreline threat probability modeling.

Also, to collect urgently needed information, we modified and extended research studies that were already underway at the time of the spill. The *Lophelia* II expedition, Loop Current monitoring, socioeconomic studies, and others are even now bringing us data to help evaluate the impacts of the spill.

We continue our work at the UAC by sharing information and expertise with our fellow Federal, State, and local agencies.



Projected trajectory of oil, July 29, 2010. *Graphic courtesy of Governor's Office of Homeland Security & Emergency Preparedness, State of Louisiana.*

We are also active on the Operational Science Advisory Team, an interagency group, that is an advisory board to the Scientific Support Coordinator at the UAC. Current activities include analyzing near real-time data to adjust sampling and making recommendations about subsurface monitoring.

JSOST.

Because of our scientific experience and decades of funded research in the Gulf, we were asked to participate in the National Science and Technology Council's Joint Sub-Committee on Ocean Science and Technology (JSOST) Principal Investigator Conference on the *Deepwater Horizon* Oil Spill.

Hosted by the University of South Florida, the October 2010 conference brought together scientific investigators from academia, research institutes, and agencies actively conducting *Deepwater Horizon* oil spill-related research, monitoring, and sampling. Conference participants established new collaborations and discussed recommendations for long-term research.

For instance, the oil/dispersant extent and fate breakout group developed recommendations related to near- and long-term research needs, such as developing a more detailed oil budget, understanding the distribution of oil on the seafloor and sediment-particle interactions, and assessing the best methods for detecting oil and dispersants in the environment.

FOR MORE INFORMATION

Restore the Gulf, Unified Area Command
www.restorethegulf.gov/

JSOST: The Deepwater Horizon Oil Spill Principal Investigator's Conference, hosted by the National Science and Technology Council's Joint Sub-Committee on Ocean Science and Technology
www.marine.usf.edu/conferences/fio/NSTC-JSOST-PI/index.shtml

Loop Current Studies and the Oil-Spill Response

Scientific information and expertise from years of BOEMRE-sponsored oceanographic studies were fundamental to the *Deepwater Horizon* spill response, particularly for modeling oil trajectories and shoreline threat probabilities.

At the time of the spill, studies and surveys that were already underway were modified to collect urgently needed data.

Water Sampling with the Loop Current Array. Fifteen months before the *Deepwater Horizon* spill, an array of moorings and near-bottom sensors had been deployed over a large portion of the Loop Current in the eastern Gulf.

The Loop Current Array was part of the BOEMRE-funded study "Dynamics of the Loop Current in U.S. Waters" conducted by Science Applications International Corporation and is one of several ongoing studies of this powerful current, which dominates and influences—directly or indirectly—almost every aspect of the Gulf of Mexico's circulation. When the oil spill occurred, this array was already in place.

When some scientists speculated that oil could be entrained by the Loop Current and carried through the Florida Keys and up the Atlantic Coast, a new task was added to the study: collecting water samples to detect oil in the Loop Current.

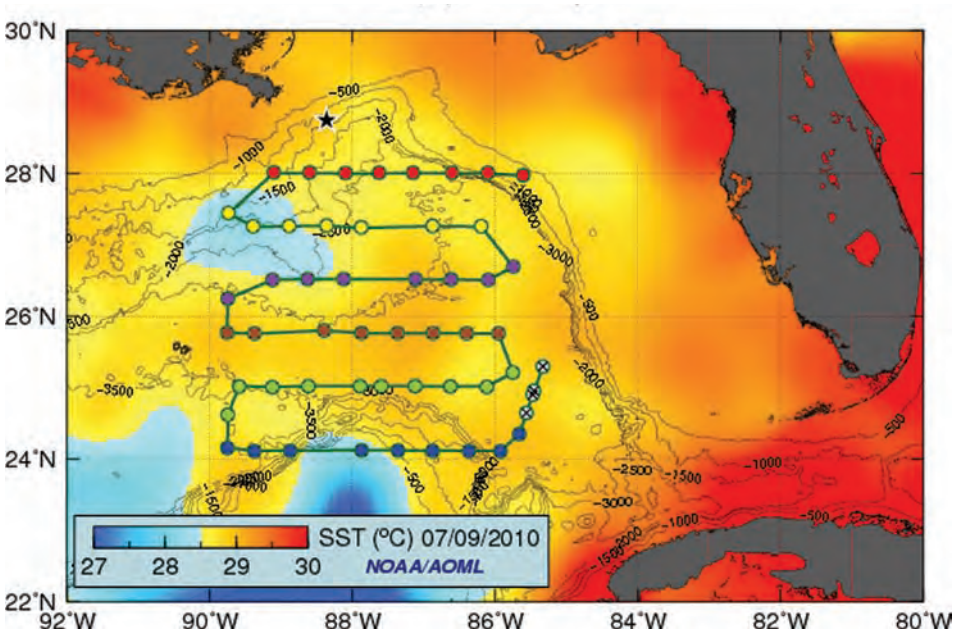
The sampling program consisted of 25 stations with 12 samples per station, for a total of 300 samples.

Water sampling was carried out during the mooring rotation cruise that had been scheduled for June 2010 aboard the Louisiana Universities Marine Consortium Research Vessel *Pelican*.

Researchers rotated all but two moorings (because of Tropical Storm Alex), recovered data from the near-bottom sensors, and conducted water sampling.

The initial data analyses indicated that no oil was present at the locations sampled.

Aerial Surveys. To study the Loop Current before, during, and after a hurricane, in September 2009, BOEMRE (then MMS) funded "Airborne Ocean Surveys over the Loop Current during Tropical Cyclone Passage." This study was to be conducted concurrently with the "Dynamics of the Loop Current in U.S. Waters" study.



Airborne expendable bathymetry thermograph sensor observations, July 9, 2010. *Image courtesy of NOAA.*

Data would be gathered by airborne surveys carried out by Dr. Nick Shay of the University of Miami from aircraft provided by the National Oceanic and Atmospheric Administration's (NOAA's) Hurricane Research Division.

But because the 2009 hurricane season was a quiet one, scientists had to wait until the next hurricane season, in 2010, to deploy their sensors.

During the *Deepwater Horizon* spill, the project was modified to collect data that could help with forecasting trajectories of spilled oil.

On May 6, 2010, we transferred the sensors to NOAA for use in the surveys. This property transfer, valued at $272,334, included 55 expendable current profilers and 55 expendable conductivity-temperature-depth sensors.

The surveys and sensors provided data about the Loop Current's location and boundary conditions for ocean models used by NOAA to forecast spill trajectories.

Also, using our data, independent researchers used simulated drifters to make long-term ensemble forecasts of how and where the oil might spread. Data included a unique set of high-resolution, multiyear, and data-assimilated analyses of wind, Loop Current, and eddy-driven currents in the Gulf of Mexico.

The data was used by NOAA to conduct oil-spill trajectory calculations. Additional analyses were carried out using a longer term dataset that took into account the then-present state of the Loop Current. The ensemble model analysis data had been gathered during years of studies funded by our bureau.

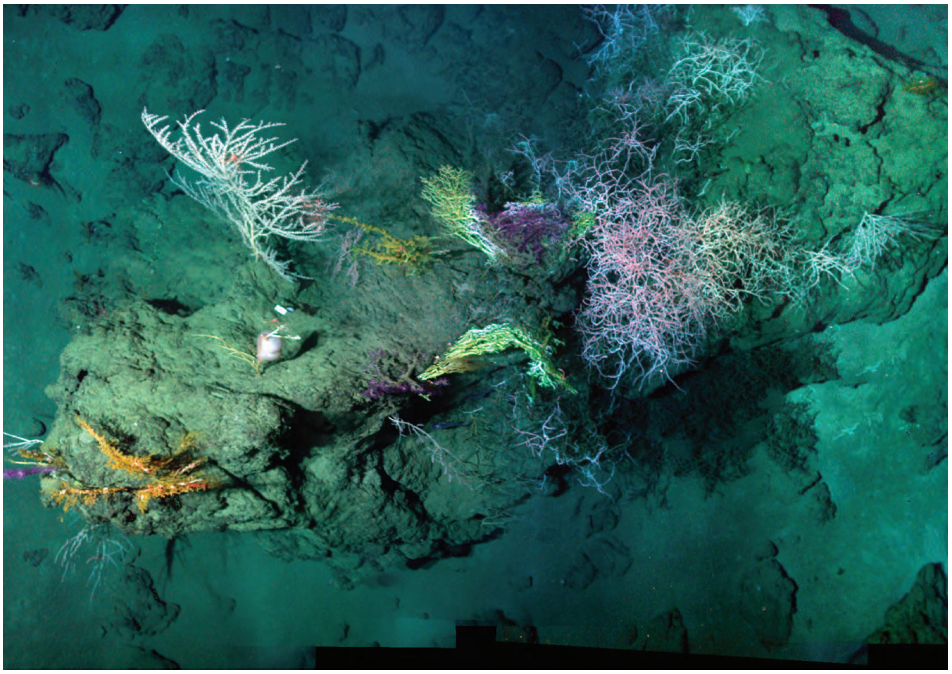
Loop Current and oceanographic research funded by BOEMRE and shared with other agencies and scientists took a central role in the *Deepwater Horizon* spill response. Our work and scientists continue to make substantial contributions to the scientific community, and thereby to the safety of the Gulf's people and natural resources.

FOR MORE INFORMATION

"The Big Picture: Mexico-U.S. Loop Current Studies," ***MMS Ocean Science,*** **Volume 6, Issue 3**
www.gomr.boemre.gov/homepg/regulate/environ/ocean_science/mms_ocean_09_jul_aug_sep.pdf

Lophelia II Expedition:

Keeping Watch over Deepwater Communities



A down-looking mosaic of a coral community at 4,600-ft (1,400-m) depth, including a variety of hard and soft corals. *Image courtesy of* Lophelia *II 2009 Expedition, NOAA-OER/BOEMRE.*

Ongoing studies help us understand systems and how they change over time. The body of knowledge gathered during years of BOEMRE-sponsored studies are fundamental for assessing long-term effects of the *Deepwater Horizon* oil spill.

Deepwater hardbottom communities—home to deep-sea corals, like *Lophelia*, and chemosynthetic communities—are a case in point. We have been studying these communities since their discovery more than 25 years ago.

Current phases of ongoing studies—like *Lophelia* II—that build on years of data and research are helping scientists understand how these sensitive ecosystems are being affected by the oil spill.

***Lophelia* II.** In 2008, the 4-year "*Lophelia* II" study of deepwater corals in the northern Gulf of Mexico began. Sponsored by the National Oceanographic Partnership Program (NOPP) and funded by BOEMRE and the National Oceanic and Atmospheric Administration's Office of Ocean Exploration and Research, the project uses highly sophisticated equipment, such as *Jason II*, a remotely operated vehicle (ROV) from the Woods Hole Oceanographic Institution, to conduct photo and video documentation and collect samples. Additional work is being done by U.S. Geological Survey scientists who contributed to and collaborated with this research effort.

In 2010, from mid-October to early November, scientists on the fourth *Lophelia* II expedition gathered more data that will help us measure and understand the oil spill's impacts by collecting water and coral samples, sediment traps, compiling photomosaics, and diving on a World War II shipwreck (the tanker *GulfOil*) covered by *Lophelia*. Researchers also visited a long-term observatory on the seafloor 10 miles from the *Deepwater Horizon* site, where equipment has been monitoring changes in gas hydrates for many years.

Sediment Traps. In October 2010, scientists collected sediment traps that had been deployed in 2009 and also immediately after the *Deepwater Horizon* spill. A sediment trap is a large funnel that feeds into a group of collection cups. Most of the traps were located in about 1,500 ft (450 m) of water.

Material in the traps gives time-series information about particles that were present at the sites since their installation in August 2009: sediment, food sources, larvae, and oil or other byproducts entering the sites.

One trap, less than 30 miles from the *Deepwater Horizon* site, had accumulated samples between September 2009 and late June 2010.

Photomosaics. A photomosaic is a constructed, photographic map of a system. Using ROVs equipped with high-resolution cameras, researchers gather images from selected sites, then assemble them to create a "wide-screen" perspective. Because some deep-sea coral communities live as long as 4,000 years or more, monitoring them is challenging. Gathering images each year from the same sites and creating, then comparing, photomosaics is one method of tracking very slow changes in coral communities over time.

Photomosaics from previous *Lophelia* II expeditions—now pre-spill baseline data—help us measure and understand how these fragile communities have been affected by natural or anthropogenic impacts.

Lophelia II scientists returned to these sites in October 2010 to collect current images for comparison to identify any visible damage and determine if these corals are still alive.

Seven miles southwest of the *Deepwater Horizon* site, 4,600 ft (about 1,400 m) deep, scientists observed dead and dying coral and brittle stars. It is not yet known if the observed impacts were related to oil from the *Deepwater Horizon* spill.

The BOEMRE and our partners continue to provide the solid data needed for assessing the impact of and recovery from the spill.

FOR MORE INFORMATION

"Cold Water Corals: Deepwater Coral Expedition in the Gulf of Mexico," *Ocean Science*, Volume 5, Issue 4
www.gomr.boemre.gov/homepg/regulate/environ/ocean_science/mms_ocean_08_oct_nov_dec.pdf

***Lophelia* II, Ocean Explorer, National Oceanic and Atmospheric Administration**
http://oceanexplorer.noaa.gov/explorations/10lophelia/welcome.html

Lophelia II Expedition:
Diving on GulfOil

In May 1942, the tanker *GulfOil*, carrying petroleum to New York from Texas, was sunk in the Gulf of Mexico by two torpedoes fired from the German U-boat, U-*506*. The first torpedo exploded amidships, causing *GulfOil* to list heavily to starboard. The second torpedo exploded near the engine room. The tanker sank in less than 2 minutes and now rests in the Mississippi Canyon Area within 20 miles of the *Deepwater Horizon* site.

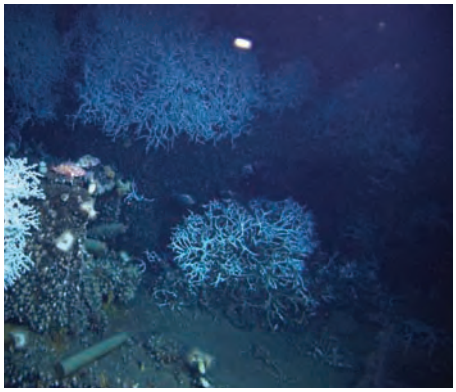
Built in 1912, *GulfOil* was a 5,188-ton tanker, 383 ft (117 m) in length with a 51.2 ft (15.6 m) beam. She was armed with only a 4-inch deck gun and two .30 caliber machine guns.

Archaeological resources such as shipwrecks are among the many resources that BOEMRE is committed to protecting and preserving. Shipwrecks are scattered throughout the Gulf of Mexico and represent several centuries of maritime activity in this region.

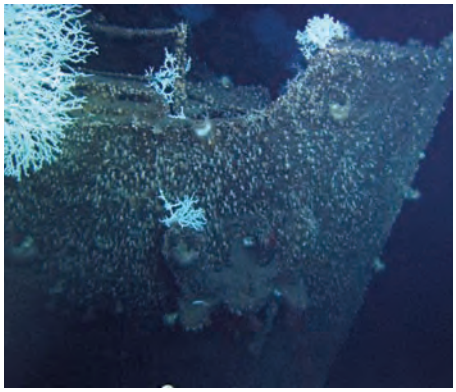
Shipwrecks also serve as artificial reefs. One mystery that we are investigating is the role of reef organisms in preserving the wrecks themselves. The answer lies at the intersection of archaeology, biology, and geology. The *Lophelia* expeditions join research of deep-sea coral communities and geological processes with marine archaeology.

GulfOil was one subject of the recent *Lophelia* II expedition. Though she had been positively identified in the Mississippi Canyon Area during the 2008 *Lophelia* II cruise, a detailed investigation was suspended when Hurricane Ike entered the Gulf.

In October 2010, marine archaeologists participated in the *Lophelia* II cruise aboard the National Oceanic and Atmospheric Administration's Research Vessel *Ronald H. Brown*. Their goal at the *GulfOil* site was to finish detailed documentation and photomosaics of the vessel remains and debris field. The information will help verify historic accounts of the sinking, evaluate the site's preservation and condition, and also study the processes at work on the wreck. The information and photomosaics will provide additional data to help with future monitoring of the site.



Spent 4-inch gun casings spill out of a box on *GulfOil's* deck. *Image courtesy of* Lophelia *II 2010 Expedition, NOAA-OER/BOEMRE.*



GulfOil's bow, with an anchor still stowed, is now inhabited by *Lophelia*. *Image courtesy of* Lophelia *II 2010 Expedition, NOAA-OER/BOEMRE.*

The *Lophelia* project is funded by BOEMRE and NOAA's Office of Ocean Exploration and Research. Participating scientists come from several universities, including Florida State, Louisiana State, Temple, and Penn State, as well as from the Woods Hole Oceanographic Institution, BOEMRE, and the U.S. Geological Survey.

Exploring around the intact hull, researchers found that the ship had come to rest stern first, leaning to port. Both masts had collapsed and are still lying on the deck.

The bow of *GulfOil* rises about 33 ft (10 m) off the seafloor. A severe bend in the stempost about halfway up is evidence of the forceful impact of the bow slamming down onto the seafloor.

Evidence of a possible third torpedo strike was an especially surprising find.

The 4-inch gun on the stern and the overturned box of empty, brass shell casings were testimony to the ship's wartime preparations. Across the transom the letters G U L F O I were clear, but *Lophelia* obscured the last letter of the ship's name.

In fact, *GulfOil* has the most abundant coral coverage of the Gulf's deepwater shipwrecks. Corals cover the wheelhouse, stern cabins, and the catwalk. But some areas have no *Lopehlia*: the decks and the hull below the waterline.

No impacts from the oil spill were observed as the corals appeared to be healthy; however, samples were collected for further analysis.

By meticulously documenting archaeological sites and learning more about the interactions of shipwrecks and corals, we can better protect these nonrenewable resources while we learn more about our own history.

Invertebrate Zoology

Since 1979, BOEMRE (formerly MMS) has contracted with the Smithsonian National Museum of Natural History's Department of Invertebrate Zoology (IZ) to provide professional collection management services for the long-term curation of its collection of marine invertebrate specimens.

More than 220,000 BOEMRE specimen lots have been curated into the IZ collection; that's almost 20 percent of the invertebrate collection records in IZ's online catalog database.

Specimens are collected during environmental studies and baseline surveys of oil and gas lease sites on the U.S. East and Gulf Coasts. These studies, begun in 1973, sample biological communities along the continental shelf to document their composition and to help predict the potential impacts of energy explorations.

These comprehensive and well-documented collections give the scientific community a wealth of research material and provide valuable educational and career opportunities.

FOR MORE INFORMATION

The Invertebrate Zoology Collection Catalog, Smithsonian National Museum of Natural History
http://invertebrates.si.edu/boemre/boemre.htm

Studying Cetaceans in the Gulf

Much of the information about cetaceans in the Gulf of Mexico is a direct result of decades of BOEMRE-funded studies and multiagency collaborations. This information was crucial during the *Deepwater Horizon* response and is important in determining how the oil spill may have affected these species and their habitat.

As early as 1989, BOEMRE (then MMS) supported a series of major environmental studies on the distribution and abundance of marine mammals in the northern Gulf. Our bureau and the National Marine Fisheries Service (NMFS) conducted aerial surveys of cetaceans over the upper continental slope in the north-central Gulf.

In the 1990's, BOEMRE (then MMS)-sponsored GulfCet studies used ship and aircraft visual surveys and passive acoustic techniques to survey the western and eastern parts of the northern Gulf to determine seasonal variability in the occurrence and distribution of marine mammals.

The endangered sperm whale has been the focus of several BOEMRE-funded studies in the last decade. The Sperm Whale Acoustic Monitoring Program began in 2000 with joint support from BOEMRE (then MMS), the Office of Naval Research (ONR), and NMFS. The 2-year program developed new methods for studying acoustic impacts and baseline whale behavior, including use of digital tags, satellite tags, and passive acoustics.

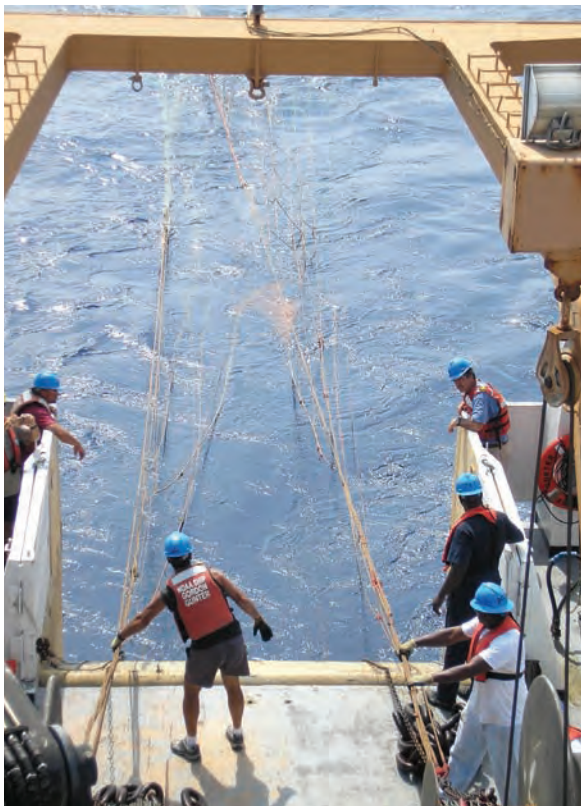
The Sperm Whale Seismic Study began in 2002 and was supported by BOEMRE (then MMS), ONR, the National Science Foundation, and a coalition of seismic and oil industry funders. Field work was completed in 2005. Recommendations included continued data collection of basic population biology parameters, such as breeding/calving, feeding and foraging, and prey species identification.

In 2009, our bureau, again working with NMFS, began the Sperm Whale Acoustic Prey Study.

Less than 2 months before the *Deepwater Horizon* oil spill, BOEMRE (then MMS) and NMFS scientists sampled sperm whale prey in the Mississippi Canyon Area. These samples help establish pre-oil spill baseline conditions.

The cetacean research we have contributed to the scientific community has given, and will continue to give, a basis for evaluating how the *Deepwater Horizon* oil spill impacted the cetaceans of the Gulf. It is solid science with which to plan mitigation and future protection of these marine mammals.

At sea, scientists sort and identify samples from the trawl net.



Crew with a trawl net during the sperm whale prey study.

FOR MORE INFORMATION

"In Pursuit of Prey: The Sperm Whale Acoustic Prey Study," *MMS Ocean Science*, Volume 7, Issue 1
www.gomr.boemre.gov/homepg/regulate/environ/ocean_science/mms_ocean_10_jan_feb_mar.pdf

Sperm Whale Seismic Study, Synthesis Report, MMS
www.gomr.boemre.gov/PI/PDFImages/ESPIS/4/4444.pdf

Listening to the People of the Gulf Coast

Field Surveys Put Boots on the Ground

Social and economic studies funded by BOEMRE support management decisionmaking by providing insight into how petroleum development affects coastal communities and their use of the environment. This long-term research effort allowed us to respond almost immediately to the information needs raised by the *Deepwater Horizon* oil spill.

When the *Deepwater Horizon* event occurred in April 2010, an experienced socioeconomic research team was already on the ground collecting data in Lafayette, Lafourche, St. Mary, and Terrebonne Parishes in Louisiana; Jackson County in Mississippi; and Mobile County in Alabama. They were working with researchers from the University of Houston and the University of Arizona on a BOEMRE-supported cooperative study of the socioeconomic implications of deepwater petroleum development.

Just 4 days after the spill began, our social scientists asked the team to develop a plan for responding to the short-, medium- and long-term informational needs raised by the spill. Because the situation was changing rapidly, it was important to get the facts directly—on the ground—from the people who were experiencing the effects.

By day 5, a field effort had begun. We also worked with Louisiana State University to modify an existing cooperative agreement to provide future support for this effort.

Currently, the study involves six senior researchers and eight graduate students in coastal areas from the Louisiana-Texas border to Alabama. The study investigates how the oil and gas industry and the spill are affecting growth and development in the region, residents' occupational choices and patterns, and in- and out-migration.

Because the spill has attracted so much national and international attention—and because the spill has affected these communities—it is paramount that fieldworkers are recognized and trusted by community members, are well versed in the issues, and are experienced in the area.

The BOEMRE's long-term socioeconomic research program is especially valuable in this regard. When contacted about this study, one community leader said, "You documenting this, getting all these different angles, like you usually do, will be invaluable to these communities. . . ." Because of previous positive experiences with this BOEMRE-supported team, there is substantial community support for this effort, even in this unfortunate situation.

To ensure that the study data are timely, relevant, and comprehensive enough to reflect the affected communities' experiences and concerns, this effort builds on a community partnership model and approach that was developed over the course of several BOEMRE-funded studies.

A field researcher talks with a fisherman at a marina in Terrebonne Parish, Louisiana.

The BOEMRE (then MMS)-sponsored project "History of the Offshore Oil and Gas Industry" received a 2010 U.S. Department of the Interior Partners in Conservation Award for its approach.

FOR MORE INFORMATION

"History of the Offshore Oil and Gas Industry in Southern Louisiana: Volume I," OCS Study MMS 2004-049.
www.gomr.boemre.gov/PI/PDFImages/ESPIS/2/2994.pdf

Mapping the Spill with Cooperatively Funded Technology

In March 2010, BOEMRE (then MMS), Ocean Imaging Corporation (OI), and the California Department of Fish and Game's Office of Spill Prevention and Response (OSPR) received the Department of the Interior's Cooperative Conservation Award for funding and developing remote-sensing and mapping technology for oil-spill response.

In May 2010, that technology was put into service during the response to the *Deepwater Horizon* oil spill in the Gulf of Mexico.

The National Oceanic and Atmospheric Administration (NOAA) and BP called on OI to use its remote sensing and mapping technology to collect valuable data for the *Deepwater Horizon* spill response. This same technology had proven its value during the 2009 San Francisco Bay tanker spill and the 2008 Santa Barbara oil rig spill.

Gathered through multispectral color and thermal infrared instruments mounted on aircraft, high resolution image data are processed while still airborne and immediately after touchdown. Fully processed oil state/thickness maps are sent to command centers within 2-3 hours after the flight.

The initial development of a portable, aerial, oil thickness mapping sensor was funded by BOEMRE (then MMS) in 2005. As research progressed, funding by our agency and OSPR continued in 2007 and 2009 (Technology Assessment & Research [TA&R] projects #544 and #594).

During the *Deepwater Horizon* spill, OI's spill mapping team mounted their instruments on NOAA aircraft and flew daily missions in the Gulf, mapping the location and thickness of oil distributions. Data helped guide oil recovery vessels with near-real-time maps of oil distribution and also helped NOAA develop their oil-spill trajectory forecast models.

The remote sensing and mapping also made it possible to document effects of the use of surface and subsurface dispersants; determine the location and thickness of the oil accumulation and the oil's weathering state; and map boundaries of the spill, including the oil reaching the shoreline.

Also underway are two BOEMRE-funded projects to test, validate, and develop similar spill-response technology for the extreme conditions and high altitudes of the Arctic (TA&R #658 and #659).

FOR MORE INFORMATION

Ocean Imaging
www.oceani.com

Technology Assessment & Research Remote Sensing Projects, BOEMRE
www.boemre.gov/tarprojectcategories/remote.htm

Groovy Drum Skimmer Goes to Work in the Gulf

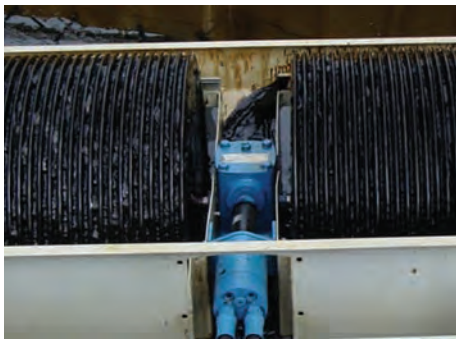
To promote new technology and safety, BOEMRE funds oil-spill research. Research on oil-spill response technology continues to lead to more effective clean up. The product resulting from one such project was put to use after the *Deepwater Horizon* oil spill.

In 2004, Victoria Broje, a Ph.D. student at the University of Santa Barbara's Bren School of Environmental Science & Management, put her imagination to work. She received funding from BOEMRE (then MMS) to examine how different skimmer materials and dimensions could be used to improve post-spill oil collection.

Broje developed a new pattern for the recovery surface of skimmers and produced them from more modern polymers. Her research showed that a hydrocarbon-based rubber and a triangular, grooved surface pattern collected up to 3 times more oil than traditional smooth skimmers.

With a second round of funding, Broje had the grooved skimmer manufactured and field tested at BOEMRE's National Oil Spill Response Research & Renewable Energy Test Facility. The skimmer successfully recovered oil at a much higher rate than previous designs.

Broje chose Elastec/American Marine to commercially produce the new skimmer, named the Groovy Drum Skimmer. Several skimmers were sent to the Gulf of Mexico to help clean up after the *Deepwater Horizon* spill. By supporting an innovative idea of a graduate student, BOEMRE made possible more efficient collection of oil in the Gulf of Mexico and contributed to better oil-spill recovery technology.



Broje's groovy drum oil skimmer, shown during testing. *Photo courtesy of the University of California, Santa Barbara.*

FOR MORE INFORMATION

"Mapping Oil Thickness in Coastal and Offshore Waters," *MMS Ocean Science*, Volume 6, Issue 1
www.gomr.boemre.gov/homepg/regulate/environ/ocean_science/mms_ocean_09_jan_feb_mar.pdf

University of California, Santa Barbara
www.ia.ucsb.edu/pa/display.aspx?pkey=2282

Elastec/American Marine
www.elastec.com/oilspill/oildrumskimmers/drums

National Oil Spill Response Research & Renewable Energy Test Facility
www.ohmsett.com

Moving Forward, Eyes Wide Open

During the *Deepwater Horizon* spill response, our previous and ongoing studies provided valuable information. They also establish crucial baseline data for post-spill assessments and future studies.

But baseline data is only one part of the equation. Without new data for comparison, they are just flat snapshots in time.

From coastal birds and deepwater corals to human communities and economies, all components of the Gulf's environment have been directly or indirectly affected by the spill.

Accordingly, much of our future research will focus on the effects of the *Deepwater Horizon* oil spill and the long-term recovery of the Gulf's interrelated natural and human systems. Some of the study areas include

- coastal and wetlands bird ecosystems and populations, including the endangered piping plover;
- marine mammals and protected species, such as bottlenose dolphins and the endangered sperm whale;
- ocean circulation modeling and hindcasting;
- physical and chemical processes of oil-sediment interactions; and
- socioeconomic assessments of direct and indirect impacts to local communities, families, economies (such as fisheries, recreation, and tourism), local tax bases, demographics, and education.

Our physical oceanography studies, which contributed significantly to the *Deepwater Horizon* response, continue to focus on deepwater circulation and the Loop Current.

A recently funded study, "A Lagrangian Approach to Study the Gulf of Mexico's Deep Circulation," is the largest continuous observational program of deepwater currents—it covers the entire Gulf basin. One result will be a map of the deep Gulf's average currents and circulation patterns at depths of 4,920 and 8,200 ft (1,500 and 2,500 m).

Submerged and profiling floats or Lagrangian drifters released in the U.S. Exclusive Economic Zone and in Mexican waters will collect data for 3 years. Trajectories of these floats will reveal circulation patterns and dynamics of deepwater eddies.

The profiling floats' bio-optical sensors will provide conductivity, temperature, and depth measurements, data on chlorophyll fluorescence, dissolved organic matter, and total particle concentration. Residues from the recent *Deepwater Horizon* oil spill, if they were trapped in the deep water, will be tracked.

Sunrise on the Gulf of Mexico. *Photo by Eric Ozolins, www.extremecoast.com.*

New studies are both filling gaps in our knowledge and building on what we have learned. Continuing with and sharing our scientific work better prepares us to protect our marine environment. Acknowledging tragedy and damage, we move forward with our eyes wide open.

FOR MORE INFORMATION

BOEMRE's Environmental Studies Program Information System (ESPIS), an online database of our studies since 1973
www.gomr.boemre.gov/homepg/espis/espisfront.asp

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BOEMRE: A steward of the ocean environment

BOEMRE Joins the Gulf Coast Cooperative Ecosystem Studies Unit

The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) is now an official Federal agency partner of the Gulf Coast Cooperative Ecosystem Studies Unit (GC-CESU). In May 2010, the Bureau's application to GC-CESU was accepted.

At the national level, CESU is a network of 17 cooperative units that include Federal agencies, universities, research and environmental groups, and others that share science-based goals. The CESUs create additional opportunities for interdisciplinary and multi-agency research, technical assistance, and education.

Each biogeographically-based CESU is located in a university. The host university provides space, administrative support, and access to faculty, staff, students, and resources.

Federal agencies contribute research scientists or other professionals, scientific staff, and project funds for specific research projects.

The GC-CESU is hosted by Texas AgriLife Research and is administered by the Texas A&M Institute of Renewable Natural Resources.

Established in 2002, the GC-CESU covers all or portions of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, and Texas. Other members include 10 Federal agencies and 25 universities and non-governmental organizations. The BOEMRE anticipates collaborating on several research projects through the GC-CESU.

FOR MORE INFORMATION

Gulf Coast Cooperative Ecosystem Studies Network
http://gccesu.tamu.edu/