

Management of Response Efforts to the *Deepwater Horizon* Spill: Perspectives from a Northern Gulf of Mexico Marine and Coastal Research Laboratory

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ABSTRACT

The offshore oil drilling rig *Deepwater Horizon* exploded on April 20, 2010, and sank two days later. Crude oil subsequently leaked into northern Gulf of Mexico waters continually for 84 days. The Gulf Coast Research Laboratory (GCRL), an academic research institution focused on marine resources of the northern Gulf of Mexico, soon after formed an oil spill operations team to manage its response to the spill. The team was comprised of marine and fisheries scientists, outreach specialists, and administrators whose objectives were to coordinate research logistics, explore approaches to obtain investigative research funding, and develop outreach strategies. Initial response efforts focused on complying with health and safety requirements through HAZMAT training and coordinating with research partners to identify immediate sampling needs. Acquiring baseline samples not available through ongoing or historical datasets was also a priority, and numerous sampling trips were funded through institutional monies to address those needs. To position GCRL for extramural funding, research concept papers were solicited from scientists for both hypothesis-driven, investigative studies and descriptive resource assessments; funding targets for investigative studies were the National Science Foundation (NSF) and the BP Ocean Trust Fund, while resource assessments would be part of the Natural Resources Damage Assessment (NRDA) process. To date, funding has been received through the NSF RAPID programs and from early release of BP Ocean Trust Fund monies. GCRL's outreach strategy focused on its scientists interpreting spill-related processes affecting marine resources, including a "town hall" meeting during which local citizens questioned GCRL scientists on spill-related issues.

KEY WORDS: Oil spill, response management, *Deepwater Horizon*

Manejo de la Respuesta al Derrame de Petroleo en la Plataforma Petrolera "Deepwater Horizon": Perspectivas de un Laboratorio de Investigacion del Norte Del Golfo de Mejico

La plataforma marina de perforación de petroleo "*Deepwater Horizon*" exploto en Abril 20, 2010, y se hundio dos dias despues. Luego durante 84 dias existio un derrame continuo de petroleo crudo en las aguas del norte del Golfo de Mejico. El Laboratorio de Investigación del Golfo de Mejico, una institución academica de investigación que esta enfocada en los recursos marinos del norte del Golfo de Mejico, rapidamente respondio al derrame luego de formar un equipo de operaciones relacionado con el derrame de petroleo. El equipo fue compuesto por cientificos relacionados con el area marina y de pesqueria, especialistas en diseminar información a la comunidad, y administradores. Este equipo tuvo como objetivo el de coordinar la logistica de investigación, explorar posibilidades para obtener fondos para las investigaciones cientificas, y desarrollar estrategias para mantener informada a la comunidad. Los esfuerzos iniciales de respuesta se concentraron en dos aspectos: cumplir con los requerimientos de protección y salud atravez de un entrenamiento llamado "HAZMAT" e identificar inmediatamente las necesidades de muestreo de acuerdo con grupos de investigación. Adquirir muestras de linea base fue tambien una prioridad en caso de que esto no fuera posible atravez de las bases de datos historicos y actuales. Estos viajes de muestreo fueron pagados atravez de dineros de la institución para poder cubrir con esta necesidad. Con el objetivo de hacer que el laboratorio recibiera fondos externos, los cientificos proporcionaron conceptos de investigación para estudios dirigidos a probar hipotesis y evaluar descriptivamente los recursos. Este plan de trabajo fue dirigido a los fondos establecidos por parte de la Fundación Nacional de Ciencias y el Fondo de Inversiones Oceano de BP. Los recursos asignados forman parte del proceso de Valoración de Daños a los Recursos Naturales. A la fecha, los fondos han sido recibidos atravez de los programas rapidos de la Fundación Nacional de Ciencias y del dinero entregado por el Fondo de Inversiones Oceano de BP. Las estrategias de información a la comunidad por parte del laboratorio se realizaron con la participacion de sus cientificos, los cuales interpretaron los procesos relacionados con el escape de petroleo y su efecto en los recursos marinos. Ademas incluyo una reunion en la cual los ciudadanos hicieron preguntas a los cientificos del laboratorio sobre los problemas relacionados con el derrame de petroleo.

PALABRAS CLAVE: Derrame de petroleo, manejo de respuesta, *Deepwater Horizon*

Coordination des Efforts de Reponse a la Maree Noire Occasionnee par l'Accident Survenu sur la Plateforme "Deepwater Horizon": Perspectives d'un Laboratoire de Recherche Localise dans le Nord du Golfe du Mexique

MOTS CLÉS: Maree noire occasionnee, recherche localise, *Deepwater Horizon*

BACKGROUND

On April 20, 2010, the Transocean-owned drilling rig *Deepwater Horizon* (DWH), contracted by BP for drilling activities in Mississippi Canyon Block 252 (Figure 1), exploded from backflow of material in its wellbore, killing 11 rig workers and injuring 17 others. The floating rig sank two days later on April 22, breaking off its well pipe near the ocean floor, and subsequently leaked crude oil into waters of the northern Gulf of Mexico (nGOM) for a period of 84 days. Although the total amount of oil leaked into nGOM waters is still a point of debate, government estimates suggest the DWH incident is the largest marine oil spill in U.S. history.

Due to the immense water depth at which the DWH rig was operating (1,522 m), response efforts to attempt to contain or stop the oil flow at the seafloor were largely untested and experimental. On May 7, a large container dome was lowered over the largest leaking well pipe (21-inch diameter) in an attempt to capture and siphon oil to a surface storage vessel; however, methane freezing in the top of the dome rendered this method ineffective. A week later, a 4-inch Riser Insertion Tool Tube (RITT) was inserted into the 21-inch leaking pipe in an attempt to siphon oil directly from the leak source, and on May 26 a “top kill” procedure to pump heavy drilling mud into the well was attempted; both of those actions were unsuccessful and discontinued. The next, and ultimately successful, effort to halt the flowing oil was attachment of the Lower Marine Riser Package (LMRP) cap containment system to the leaking wellhead on July 12. After testing its implementation, it was determined on July 15 that the LMRP had halted the flow of oil into nGOM waters. Static condition of the well was reached on August 4 after drilling mud was pumped into the well to seal it.

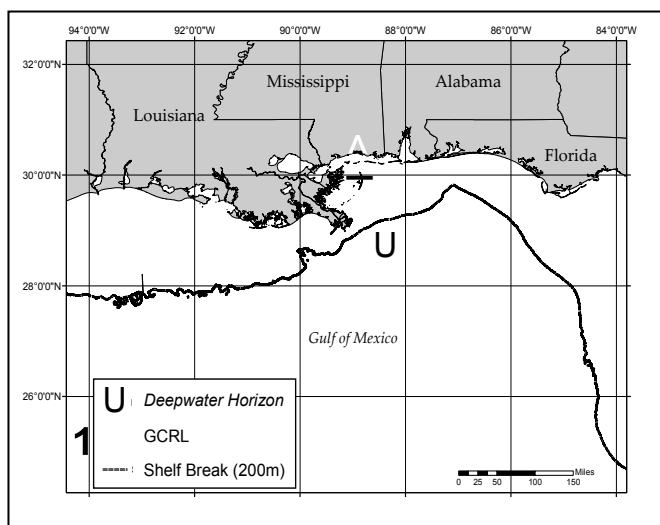


Figure 1. Location of the *Deepwater Horizon* drilling rig on April 20, 2010.

To date, uncertainty remains as to the amount of oil leaked into waters of the nGOM. On April 24, BP estimated oil to be leaking from the well at a rate of 1,000 barrels (42,000 US gallons) per day, but National Oceanic and Atmospheric Administration (NOAA) officials in Seattle, Washington, suggested the leak was 5,000 barrels per day (210,000 US gallons) on April 28. To obtain a more accurate, scientifically-based assessment of the rate of leakage from the broken riser pipe, the National Incident Command established the Flow Rate Technical Group (FRTG), composed of members from federal government, academia and independent organizations. The initial FRTG estimate of oil flow on May 27 put the daily leakage rate at 12,000 to 19,000 barrels (504,000 to 798,000 US gallons; USG 2010a), an estimate which was increased on June 10 by the FRTG's Plume Modeling Team to as little as 20,000 to 40,000 barrels per day (840,000 to 1,680,000 US gallons; USG 2010b). On August 2, the FRTG reported that 62,000 barrels of oil per day (2,604,000 US gallons) were initially leaking from the well, decreasing to 53,000 barrels per day (2,226,000 US gallons) at the time the well was capped on July 15; overall, government scientists estimated that a total of 4.9 million barrels (205.8 million US gallons) of oil were released from the well, with 0.8 million barrels collected through containment activities (USG 2010c).

Previous oil spills have employed dispersants both at the water surface to fragment surface slicks into finer oil droplets that are more rapidly diluted in the water column and at depth to prevent oil from reaching surface waters where it could potentially cause more ecological harm (EPA 2010a). On May 15, the U.S. Environmental Protection Agency (EPA) authorized the application of dispersant at the DWH leak source (USG 2010d), to be conducted under guidelines set forth in a May 10th EPA directive to BP (EPA 2010b); the EPA on May 26 directed BP to scale back dispersal use (specifically, Corexit 9500 and 9527) due to the uncertainty about potential impacts from its application (EPA 2010c). As of September 14, approximately 1.84 million gallons of dispersant had been applied in response to the DWH oil leak, 1.07 million gallons of which were applied to the water surface and 771,000 gallons at the leak source (USG 2010e). While Corexit 9500 alone was shown to be only slightly toxic in laboratory studies conducted on mysid shrimp, *Americamysis bahia*, and inland silverside, *Menidia beryllina* (Hemmer et al. 2010), the general concern over the use of dispersants was the potential for increasing the bioavailability of oil for uptake by organisms and the unknown biological/ecological implications therein. Whether or not dispersant application and its stated intent of keeping subsurface oil from reaching the surface outweighed any potential negative impacts of dispersant use will be the source of extensive scientific study in the future.

The purpose of this paper is not to debate the specific events of or the subsequent responses to the DWH oil

disaster, nor is it to present scientific findings from investigations of potential ecological impacts from the release of oil into nGOM waters. Those issues will undoubtedly be debated and studied in great detail over the next several years. Rather, the purpose here is to provide an overview of a marine laboratory's response to the DWH disaster from an institutional perspective.

LABORATORY RESPONSE

The University of Southern Mississippi's Gulf Coast Research Laboratory (GCRL) is a coastal and marine research laboratory located in Ocean Springs, Mississippi, with broad expertise in and knowledge of local marine resources. Given its geographic location, GCRL was physically and functionally positioned to respond rapidly to scientific service needs related to the DWH oil leak. Scientists at GCRL have conducted coastal ecosystem and marine resources research in the nGOM, and especially in the Mississippi Sound, since 1947. As a result, GCRL has developed a robust database on this highly productive and biologically diverse ecosystem, including comprehensive and ongoing legacy studies of biological communities ranging across the entire Mississippi Gulf coast out to and beyond the coastal barrier islands. Being physically located approximately 100 miles north of the DWH site (Figure 1) and having access to a diverse vessel fleet, GCRL scientists had the opportunity to respond quickly to the oil leak by conducting research activities in support of baseline sample collection and subsequent impact assessments.

Given the scope of the DWH oil leak and the anticipated efforts that would be required in its wake, GCRL formed an oil spill operations team to manage its response to the leak. The team included marine and fisheries scientists, outreach specialists, and administrators whose objectives were to coordinate general and research-based logistics, explore approaches to obtain investigative research funding, and develop outreach strategies. The team met at least every other day for several weeks subsequent to the spill.

Inter-Agency Coordination

A primary task in GCRL's response to the DWH disaster was to coordinate with federal and state partner agencies on logistical matters. First and foremost was employee welfare and complying with health and safety requirements for those involved in spill research. To safeguard personnel, field researchers who might be sampling in oil-affected waters were required to be certified through 24 hours of Hazardous Waste Operations and Emergency Response (HAZWOPER) training, while laboratory personnel handling oiled samples would require six hours of HAZMAT awareness training. Given the scope of the DWH disaster and the subsequent response efforts, a large number of people in the community were subject to these requirements, so GCRL offered its meeting

facilities and classrooms for health and safety training. In May and June, several training sessions were held on the GCRL campus for federal, state and university employees; numerous vessel operators and field researchers from GCRL attended those three-day HAZWOPER and one-day HAZMAT courses.

Response to the oil spill also affected what would normally be routine activities, a consequence that required heightened communication with partner agencies. For example, to protect coastal waters and habitats surface booms were placed at island passes, at the mouths of inlets and bays, and around critical habitats, with the intent of preventing the passage of surface oil into coastal waters. On several occasions, GCRL research or educational activities were delayed or canceled as a result of boom placement across critical access points with no tender present to allow passage through the impediments. In such cases, communication with state officials was required in order for vessels to continue with their planned activities. Associated with the booms were vessel decontamination sites that were coordinated by the state to clean oil from the external surfaces of vessels operating in impacted waters prior to the vessel's passage into boom-protected waters. Because the GCRL harbor is located on Davis Bayou which feeds into Biloxi Bay, both bodies of water protected by booms, GCRL vessels that entered oil-impacted waters were subject to decontamination before returning to port. Tentative GCRL plans for vessel decontamination involved launching and retrieving sampling vessels at an off-site public launch that offered decontamination services. Similarly, the homeport for GCRL's 98-foot oceanographic research vessel the *R/V Tommy Munro* was located in boom-protected waters, and oil contamination of that vessel would have prohibited its return to homeport until it underwent decontamination cleaning. Fortunately, no circumstances arose that necessitated decontamination of GCRL vessels.

Because response to the oil spill was anticipated to impact GCRL resources such as personnel time, vessel usage, and associated materials and would be above and beyond normal budgetary scopes, the mechanism for reimbursement of oil-related costs incurred was discussed early in the coordination process. Through the state and federal partners involved in the planning process, it was determined that all entities involved in response efforts should follow protocols developed and approved in conjunction with BP in order to be eligible for reimbursement. Reimbursement was to ultimately be paid by BP through invoices submitted by the individual states or at the federal level. Consequently, GCRL communicated frequently with the Mississippi Department of Environmental Quality (MDEQ), the Mississippi Department of Marine Resources (MDMR) and the NOAA Fisheries Pascagoula Laboratory, where appropriate, to ensure compliance with the various protocols which were enacted. An internal accounting system of oil-related efforts and

expenses was established to track and log the considerable resources devoted to the DWH response.

Baseline Sampling

GCRL has an extensive and diverse set of historical data on the biological communities and ecological components of coastal Mississippi waters, which will serve as valuable baseline data for DWH environmental damage assessments. Despite the logistical difficulties in the aftermath of the DWH disaster, GCRL scientists continued their sampling efforts for ongoing monitoring and assessment studies and were successful in maintaining the continuity and integrity of those data sets. However, because of the nature of the DWH spill, a great deal of uncertainty persisted relative to the amount of oil present (particularly subsurface oil), the locations of that oil, its condition of weathering and its relative toxicity. Consequently, emphasis was placed on acquiring baseline samples that were not available or had not been attained through ongoing or recent studies. Where possible, researchers utilized vessel time and samples obtained through funded research projects; however, the specificity of many scientific needs to assess the oil effects required directed sampling trips that were self-funded by GCRL. One such effort was a research cruise on the *R/V Tommy Munro* in Gulf waters south of the Mississippi barrier islands, an area which was generally not sampled through ongoing research efforts. That cruise, as well as numerous inshore trips, focused mostly on obtaining samples of specific organisms, such as finfish and invertebrates, for background toxicological, histological and parasitological data, and on collecting water and sediment samples for chemical and microbial analyses.

At the request of the State of Mississippi, GCRL resources were also tasked for sample analyses outside the scope of normally funded research efforts. Not surprisingly, the DWH oil spill heightened public awareness of conditions in Mississippi coastal waters, and numerous reports of potential oil incursions, characterized as discolored water, were received by the MDMR. In most instances, MDMR staff requested the analytical services of the GCRL microbiology section to evaluate suspect water samples for abnormally high phytoplankton levels that could cause water discoloration; subsamples of those collections were also sent out for chemical analysis by contract laboratories. Because of the public concern, GCRL microbiologists worked diligently to analyze those samples and report their findings to MDMR as quickly as possible. All samples that were analyzed by GCRL did, in fact, exhibit high plankton levels, and most if not all reported incidents were attributed to plankton blooms and not to oil.

Although the majority of GCRL research activities were not adversely impacted by the oil spill, some studies required modification in order to proceed, while others were postponed indefinitely. For example, the summer

groundfish survey for the Southeast Area Monitoring and Assessment Program (SEAMAP), which is normally conducted by GCRL in Gulf waters east and southeast of Chandeleur Island, Louisiana, was modified at the request of NOAA Fisheries due to the close proximity of some of those trawl stations to the DWH site. The high likelihood of encountering oil in that region prompted NOAA to assign those stations to one of its own research vessels and subsequently shifted GCRL efforts to the east, where it had historically not operated. More critical, though, were those research projects that could not be accomplished because oil forced area closures or presented hazards to sensitive sampling equipment. Some projects were also affected by shifts in personnel effort from research to oil-related responsibilities. Fortunately, funding agencies were considerate of these extraordinary circumstances and in most cases have approved no-cost extensions to grants.

External Funding

As an academic research institution, one of the primary responses by GCRL was coordination of its faculty and researchers to prepare to investigate potential ecological impacts of the DWH oil spill. At the same time that logistical matters were being sorted out, research concept papers were prepared by scientists for both hypothesis-driven, investigative studies and descriptive resource assessments in order to position GCRL for extramural funding. The primary funding targets for investigative studies were the National Science Foundation (NSF) and the BP Ocean Trust Fund, while resource assessments would be part of the federal Natural Resources Damage Assessment (NRDA) process. To be prepared to respond rapidly to funding announcements, GCRL developed comprehensive plans for ecosystem response/recovery studies and fisheries monitoring research that could be used in whole or part in response to funding opportunities.

To date, GCRL has received directed funding through the NSF RAPID program and from early release of BP Ocean Trust Fund monies, administered by the Northern Gulf Institute (NGI). Those funds are currently supporting several research and outreach projects examining ecosystem impacts in Mississippi coastal waters, in the nearshore Gulf, and at deepwater areas around the DWH site, including investigations of:

- i) Inshore and nearshore plankton community structure;
- ii) Deep-sea (*Geryon*) crabs;
- iii) Larval blue crab recruitment;
- iv) Inshore and deep-sea benthos;
- v) Dispersed oil exposure on molecular biomarkers;
- vi) Parasitological and histological parameters;
- vii) Oil and dispersant effects on bacterial respiration;
- viii) Microbial response to oil and dispersant;
- ix) Impacts to saltmarsh habitats;
- x) Juvenile fishes associated with pelagic *Sargassum*.

- sum*; and,
- xi) Responsive, multi-media outreach to the general public.

Funding for continuation and expansion of those initial studies will be sought from a secondary release of NGI funds and from the remainder of the Ocean Trust Fund, as calls for proposals are released. As other funding mechanisms are established, GCRL will actively pursue support through those sources for components of its comprehensive plans and to expand upon preliminary findings and research.

In addition to the competitive proposal process, GCRL scientists have been intimately involved in the NRDA, a process by which impacts to resources are assessed and quantified and affected resources are ultimately restored. The NRDA process is a collaboration among resource “trustees”, which for the DWH oil spill includes NOAA, the U.S. Fish and Wildlife Service and representatives from each of the five U.S. Gulf states; representatives for the “responsible party”, in this case BP, have also been actively involved in the process. Since May, GCRL researchers have served on various NRDA Technical Working Groups (TWG), participating in numerous meetings and conference calls to identify baseline data sources, prioritize resources that require impact assessments, and develop sampling plans to quantify resource injury. As a result of this participation, GCRL has conducted sampling of whale sharks in the nGOM in support of the NRDA assessment and is presently one of two institutions that will conduct field and laboratory assessments of fishes and invertebrates inhabiting *Sargassum* habitat in the nGOM through the NRDA *Sargassum* Sampling Plan. Additionally, GCRL has teamed with private consultants working on behalf of the resource trustees to provide scientific expertise for the NRDA process and will continue to assist its federal and state partners in the damage assessment process.

Media Relations and Outreach

Because of the scale of DWH oil spill, media attention throughout the world was focused on the events following the sinking of drilling rig. Given the standing of GCRL in the marine and coastal sciences community and its geographic proximity to the spill site, media requests for interviews of its faculty and scientific staff were substantial. Management, approval and assignment of those interview requests fell to the GCRL Public Information department in collaboration with the oil spill operations team. The GCRL outreach strategy focused on its scientists interpreting spill-related processes potentially affecting marine resources. In total, an estimated 780 print and video interviews have been given by GCRL researchers, a number that continues to grow six months after the rig’s sinking.

From the outset, emphasis was placed on maintaining GCRL’s role as an objective and independent scientific research entity by not speculating as to specific impacts that had yet to be sufficiently investigated. Rather, GCRL focused on general concerns by its scientists based on their knowledge of the local coastal ecosystem and on scientific facts resulting from studies of prior oil spills. The general consensus among researchers was that speculation would only jeopardize the scientific independence of GCRL and potentially carry economic consequences that would negatively impact local businesses, many of which were just exiting the recovery stage after Hurricane Katrina in 2005. With those issues in mind, GCRL accommodated all legitimate media requests by giving interviews on and off campus, participating in panel discussions, and inviting reporters to accompany scientists on sampling trips aboard its research vessels.

Mindful of the many questions and concerns of the general public, GCRL held a “town hall” meeting as part of the University of Southern Mississippi’s *Issues + Answers* seminar series. The meeting featured a panel of GCRL faculty and researchers, each of whom spoke briefly on oil-related aspects of their particular disciplines, and concluded with an open forum session, during which local citizens questioned GCRL scientists on spill-related issues. An estimated 250 citizens attended the town hall meeting.

Additionally, the GCRL Marine Education Center initiated an NSF-RAPID funded multimedia outreach program entitled “Science of the Spill”, which includes three one-hour television broadcasts, news-style video packages and a companion website. The project focuses on the many complex topics related to the oil spill using basic, accessible terminology. A companion web page (www.spillscience.com) is moderated and includes additional interviews with and blogs from scientists, a Frequently Asked Questions section (with answers), and a selection of accurate resources which are annotated to help page users find additional information.

CONCLUSION

The DWH spill is the largest marine oil spill in U.S. history. With that disaster came unprecedented consequences for the northern Gulf ecosystem and those who study it. While the potential ecosystem impacts will be the focus of both scientific and legal investigation for many years to come, it is the intent of this paper to provide a general overview of GCRL’s response to the oil spill in the days and weeks following April 22, 2010. It is the authors’ hope that the information presented herein may assist other institutions to respond efficiently and effectively should such an unfortunate event occur again in the future.

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