Statement of
Marcia K. McNutt, Director
U.S. Geological Survey
Department of the Interior
Before the
Committee on Natural Resources,
Subcommittee on Insular Affairs, Oceans, and Wildlife
U.S. House of Representatives
June 15, 2010

Good morning, Chairwoman Bordallo and Members of the Subcommittee. I am Marcia McNutt, Director of the U.S. Geological Survey and Science Advisor to the Secretary of the Interior. The Department of the Interior and its bureaus have responsibility for a spectrum of natural resources in the Gulf that may be impacted by the oil spill, including 35 National Wildlife Refuges and 10 National Park units, migratory birds, and threatened and endangered species, such as manatees, and sea turtles.

Before I begin, I would like to extend my sympathies to the families of those who lost their lives in the explosion and sinking of the Deepwater Horizon, to those who were injured, and to those whose way of life has been changed for years to come.

The impacts of a disaster such as this must be considered in the time frame of not weeks and months, but of years to decades. Oil can remain toxic in the environment over long periods, and it has chronic harmful effects that will impact the interconnected systems and communities of living things—including people—throughout the Gulf region for many years.

The USGS is home to a breadth of multidisciplinary science expertise, an extensive, national, on-the-ground presence, and a wealth of biologic, geologic, geographic, and hydrologic monitoring capabilities and existing data, in scales ranging from microscopic to global. Long-term monitoring capabilities have positioned the USGS to understand changes in the environment – from water quality to ecosystem structure and function to land cover. This broad capacity, combined with a presence in all 50 States and Puerto Rico, enables the USGS to bring science immediately to bear not only on natural hazards such as earthquakes, floods, and volcanoes but also on environmental hazards. For more than a century, the USGS has been on point in response to natural disasters; this experience and expertise have uniquely prepared the USGS for dealing efficiently and effectively with the challenge that lies before us today and the challenges that will face our Nation in the weeks, years, and decades to come.

Thank you for the opportunity to discuss the importance of data and analysis about the complex estuarine, coastal, and marine environments of the Gulf. This kind of scientific information is essential for effectively targeting response activities, such as determining the volume of the spill as well as providing information useful for

mapping. The USGS will work closely with other DOI agencies, such as the U.S. Fish and Wildlife Service (FWS) and the National Park Service (NPS), as well as National Oceanic and Atmospheric Administration (NOAA), the states, and affected tribes to provide scientific information necessary to conduct damage assessment and restoration activities.

EXISTING DATA GAPS

The greatest challenge in characterizing the fate and transport of contamination resulting from the flow of oil and gas from the Deepwater Horizon drilling site lies in a combination of factors: the volume of oil, the expanse of sea, air and land into which it flows, and the biodiversity of the ecosystems that it is impacting.

The first step is to document and understand the physical processes that control the movement of contaminants from the open ocean into the coastal zone. Both surface and submerged oil and oil-dispersant mixtures will be a source of contamination to coastlines and the sea floor for a prolonged period of time and may be transported long distances by surface and subsurface currents. The goals of dispersing oil are to make oil more readily processed by organisms that can break it down and to enhance dilution to reduce the toxicity of oil. In order to understand the long-term extent and impact, predictions are needed to determine where and when new coastal and sea exposures are expected. Remobilization of stranded oil or surfacing of submerged oil may occur during hurricanes; forecast models of storm impacts and oil transport will be needed to identify the worst case scenarios and help prioritize cleanup and protection efforts.

The coastal zone is a dynamic system at the land/sea interface. The individual components of the system – including the continental shelf, deep and shallow coral reefs, barrier islands, beaches, bays, estuaries, and marshes – are interconnected and influence each other. The barrier islands of Louisiana, Mississippi and Alabama are an especially dynamic component of the coastal zone in the northern Gulf of Mexico and are critical to the health and function of the entire system. The barrier islands provide a defense against waves, currents, and storm surge for estuaries and wetlands. They also contain important habitat types, such as beach, dune, barrier flats, back-barrier saline marsh, and intertidal flats that are used by a variety of plants and animals including migratory birds. The physical presence of the barrier islands and locations of inlets influence salinity of waters behind them and, in combination with associated wetlands, help maintain water quality. The components of the coastal system are constantly changing due to the movement of sediment (deposition and erosion) driven by action of winds, currents, waves, and storms. Comparative shoreline studies by the USGS and others of the Louisiana coast over the past century show high rates of retreat, land loss and movement of barrier islands at widely different rates, resulting in 13 feet or more of shoreline retreat per year. In the past decade, a number of devastating hurricanes have severely damaged the barrier islands of the northern Gulf, further reducing their effectiveness in mitigating the impacts of storm surge, waves, and, now, oil spills to the mainland.

The long-term impact of the Deepwater Horizon oil spill on the northern Gulf and other coastal systems will depend on how the oil and oil degradation products are incorporated and cycled among the various components of the coastal system. A wide range of data and analyses will be needed in the short-term as well as the coming months and years to fully understand the extent and trajectory of the oil from the spill:

- Detailed characterization of the extent, concentrations, and chemical signatures of source oil and dispersant;
- Information on migratory birds and other fish and wildlife that might enter an oiled area; this information may be used to help deter species away from oiled areas as well as to prioritize clean up actions;
- Detailed organic component analysis of samples taken across a range of locations and time frames, to develop compound-specific information about dispersal, dissolution into water-soluble forms, settlement onto sediments or surface soils, and eventual degradation by microbes;
- Data for describing attenuation and biodegradation/mineralization /photo-oxidation of the oil over time and space;
- Better accounting for the oil in space and time in the subsurface;
- Visual and meteorological records of surface conditions and the surface slick; and
- Landfall data - dates, locations, estimated volumes/mass, and characteristics of the oil and tar.

Using a variety of techniques, a group of federal scientists, independent experts, and representatives from universities around the country are participating in the Flow Rate Technical Group (Group) to estimate the volume of oil resulting from the Deepwater Horizon oil spill. We are continuing to analyze data and refine the estimates including an evaluation of the flow rate after the riser was cut.

The USGS and other Federal agencies are providing support to the NOAA, which has the primary responsibility for mapping the extent and trajectories of oceanic oil plumes. For example, NOAA and MMS are working together to drop sensors to map the extent of oil plumes. The USGS is collecting baseline data along the coastline, developing maps that show NOAA projections of spill trajectory with respect to DOI lands, and developing models that depict how local tidal and current conditions will interact with seafloor bathymetry to carry oil over barrier islands. We have worked with the National Aeronautics and Space Administration (NASA) to provide a combination of satellite and airborne imagery to assist NOAA in forecasting the trajectory of the oil and to document oil impacts on the coastal and nearshore ecosystem and are collecting satellite imagery to assess the impact on coastal wetlands.

PRE- AND POST-IMPACT SPILL DATA

Important to any scientific investigation of the effects of an oil spill on the environment is a complete understanding of the pre-existing condition, or baseline

condition, of the water, sediment, and biota prior to landfall of the spill. For the most part, the data needed after the spill will be the same as the baseline data collected pre-spill, so that changes related to oil spill or oil spill mitigation efforts can be quantified and characterized by how these relate to the baseline condition.

USGS Science Centers in Texas, Louisiana, Mississippi, Alabama, and Florida have coordinated efforts to sample water and bottom material from coastal wetlands, DOI lands onshore, and the barrier islands most likely to be impacted now that the oil has come ashore. The USGS has documented current conditions at these sites and the existence of any historic oil present, including "fingerprints" of existing oil, polycyclic aromatic hydrocarbons (PAHs), oil and grease, trace metals, volatile organic compounds, surfactants, dissolved organic carbon (DOC) characterization, bacterial populations capable of digesting oils, nutrients, and bottom-dwelling invertebrates. Scientists are monitoring radio-tagged manatees for deviations from normal behavior in priority areas on the Gulf Coast of Florida. Aerial surveys of mangroves and wetlands along the Gulf coast of Florida are being conducted to differentiate between damage from the January 2010 freeze and any potential impact from the oil spill. Aerial surveys and sub-bottom profiling of sea grass beds along the Louisiana coast to document current pre-spill conditions were completed during May 2010.

Trust species are a major focus of DOI management agencies and include threatened and endangered species, as well as migratory birds such as waterfowl, wading birds, shorebirds, and neotropical songbirds. The Department's Natural Resource Damage Assessment and Restoration (NRDAR) Program allows DOI agencies, such as the FWS and NPS, with trust responsibilities to document injury to natural resources as a result of oil spills or hazardous substances releases, assess damages, and restore those injured resources. The USGS provides information and science support to FWS, NPS and other federal agencies to assist them in all phases of the NRDAR process. Currently, USGS scientists are providing scientific support to the DOI NRDAR Program and NOAA Damage Assessment, Remediation, and Restoration Program (DARRP) with regard to the Deepwater Horizon incident on more than a dozen technical work groups, investigating topics that range from aerial imagery to deepwater corals to data management to terrestrial and aquatic species.

While current USGS efforts are focused on response in the aftermath of the oil spill, USGS managers and scientists are also planning for future research needs associated with the Deepwater Horizon oil spill. A longer-term Science Planning Team was launched in early May 2010. The team, which includes personnel from the FWS, the NPS, and the MMS representing their bureaus' science and resource management needs, is developing a long-term science plan designed to address the research needs as we move from an immediate response to a more mature response phase of this event and into recovery. The team has identified priority baseline data that should be collected; a few examples are briefly described below:

- *Mapping and resource characterization*. Habitat maps are lacking for many of the estuaries, sea grass beds, coral reefs and salt marshes in parks and refuges that will be directly or indirectly affected by the oil spill, and their plant and animal communities are poorly understood or quantified, all of which hinders the NPS and FWS from responding. Scientifically valid habitat maps and information on extent, abundance and distribution of marine habitats and species are needed. The barrier island systems in the northern Gulf (especially MS, LA) are very dynamic, and some are on the verge of disappearing. The USGS has joined with the U.S. Fish and Wildlife Service's National Wetlands Inventory program to produce wetland maps that highlight resource-rich areas that are protected by federal, state, or non-governmental agencies to aid in prioritizing response efforts. While the USGS has collected good post-Katrina bathymetry, shoreline, and geomorphology data on the Louisiana and Mississippi barrier islands, but additional island surface and marine habitat data are still needed to complete updated maps.

- *Surveys and assessments*. Specific resources of interest include submerged aquatic vegetation (SAV); near-shore and marsh vegetation and associated invertebrate and vertebrate communities; near-shore fish; shorebirds with emphasis on roosting/nesting areas; sea-turtle nesting areas; shallow-water coral reefs; deep-water coral communities; water quality; and sediment. A portion of the water quality and sediment monitoring stations should be targeted at SAV beds and shallow and deep coral communities.

- *Surveys to document the occurrence of oil and oil-related materials*. The surveys should include sediment and pore water sampling, seafloor and shoreline imaging with both geophysical and optical techniques, and oil detection LIDAR. The results will be used to map the occurrence and amount of oil and oil-related materials.

- *Surveys at berm and borrow sites*. In addition to physical characteristics, the surveys will need to include water column and sediment measurements to determine if oil-related or previously sequestered harmful materials have been resuspended and reintroduced to the system. The berms will decrease the tidal flows, on which the coastal marshes depend; surveys should also document the effects on the marshes of reduced tidal flow.

Sources and sinks of oil and oil-related materials will vary through time and will be affected both by natural processes and oil spill mitigation activities. Repeated surveys of the coastal zone will need to be performed to determine changes in the physical systems and document changes in the character and distribution of oil and oil-related materials. The repeated surveys will be used to develop "change maps" that will track the migration of oil and oil-related products in the systems. Repeat surveys to track movement of sand in areas of borrow and oil-protective berms will need to be done frequently because analysis of the berm construction plan suggests that the artificial structures could be unstable.

Processes involved in transmitting oil and oil degradation products through the coastal system will need to be monitored. Analyses of sediment and pore water samples taken during repeat surveys can be used to investigate the processes responsible for mobilizing, transmitting, and degrading oil within different components of the coastal system and to document how the presence of oil and its degradation products affect the structure and function of these ecosystems. These analyses also will provide information on interaction of oil and the degradation of oil with other processes such as development of hypoxia and mobilization of toxic metals in different components of the coastal system.

Wildlife Resources and Coastal Ecosystem Impact Recovery

DOI will need to understand the impacts of the Deepwater Horizon oil spill on wildlife and coastal ecosystems in the Gulf of Mexico and track their recovery. Lessons learned from the Exxon Valdez oil spill suggest that a long-term (on the order of decades), multi-level, ecosystem perspective will be essential. Therefore, we recommend that studies include investigations at the landscape level as well as those that are localized and include process-based research. The studies should include habitat monitoring, characterization, and mapping using ground-based data collection, and remote sensing systems. Trust species, including migratory birds, manatees, and sea turtles, which are of concern to the public and resource managers in the DOI, should be emphasized. In addition, the effects of the oil spill on ecosystem structure and function, especially in relation to the health of coastal ecosystems, need to be monitored to measure the impacts to the natural resources of the Gulf.

At the ecosystem level, studies will be needed to

- determine how oil and dispersants will impact multi-level pathways in coastal ecosystems, from the nearshore to coastal wetlands;
- understand the influence of oil and dispersant exposure on the resilience of coastal ecosystems;
- determine extent and degree of damage to coastal ecosystems; and
- use assessments of coastal habitat impacts to model long-term recovery and support the development of remediation/restoration plans.

At the population level, research should focus on

- impacts to wildlife populations and estimated recovery times;
- effects of the oil spill on distributions of marine fauna and wildlife populations;
- impact of sand berms on coastal wetlands and wildlife habitat;
- the efficacy of other remediation methods such as fire or low-pressure hydro-cleaning in wetlands; and
- habitat management techniques to restore, enhance or establish conditions necessary to establish or maintain native plant and animal communities.

At the species level, monitoring and analysis will be needed to determine

- sub-lethal effects of oil and dispersant on marine, aquatic and terrestrial organisms;
- impacts of burial and later ingestion of oil and dispersants on wildlife health, life history, and behavior;
- effects of oil and dispersants on marine, aquatic, wetland and terrestrial plants; and
- effects of disturbed conditions on plant community structure and function.

These studies will help to inform the U.S. Fish and Wildlife Service's developing Information, Planning, and Conservation (IPaC) decision support system, which the FWS is currently attempting to secure the needed resources to deploy for the Gulf spill response activities. This system is designed to aid in streamlining emergency section 7 consultation while improving efforts to conserve trust resources, assess impacts to species conservation, and identify appropriate mitigation activities for the NRDAR process. This system is currently being integrated with NOAA's Environmental Response Management Application (ERMA) to allow users to seamlessly move between the two systems to obtain information about FWS trust resources and recommended best management practices. This system integration results in users only having to visit one location to obtain information regarding both agencies' trust resources.

Socio-economic Issues and Ecosystem Services

Impacts of the oil spill to both communities and ecosystems will be far-reaching and long-term throughout the Gulf of Mexico, where many coastal communities depend on ecosystem services for their livelihoods, quality of life, and protection from natural hazards. Information on these impacts on economic activities, demographics and ecosystem services, as well as options for adaptation and resilience planning, are needed to help communities try to regain pre-spill productivity and social well-being. Restoring economic activity and quality of life is best achieved through an adaptive management framework: a structured, iterative process of optimal decision making in the face of uncertainty, with an aim of reducing uncertainty over time via system monitoring. In this framework, science will inform resource managers of specific options for restoration, and consequently the restoration effort will guide the science that needs to be done.

Research on the socio-economic impacts of the oil spill is important to comprehensively assess the impacts of the oil spill on coastal communities, by comparing the social, economic and demographic changes that have occurred as a result of the oil spill as well as the social and economic impacts of restoration activities. A comprehensive geographic analysis of the socio-economic impacts of the oil spill to communities in the Gulf would include:

- Characterization of pre-spill socioeconomic conditions in coastal communities across the Gulf to set the baseline;
- Assessment of current community exposure to hurricane storm-surge hazards relative to areas containing significant oil residue, providing decision makers with an idea of where post-hurricane clean-up would be complicated by oil residue in flood waters;
- Characterization of socio-economic conditions in coastal communities one year after the initial oil spill, to assess the immediate impacts of the oil spill;
- Trend and regression analyses of demographic shifts in coastal populations and business distributions;
- Community-based workshops in communities identified as hot-spots of significant socio-economic change after the oil spill, identifying system-level consequences of the spill to local community structure and function; and
- Models to evaluate the economic impacts of various restoration plans, including the number of jobs created within various economic sectors. Outcomes should include application of these models to inform decision-making.

Ecosystem services are the multitude of resources and processes that are supplied by natural ecosystems to humans, enabling our continued existence and our complex social systems. A science-based Gulf restoration strategy requires examining the value of all ecosystem products and services that have been impacted by the oil spill, including: provisioning services such as food and water; regulating services such as water purification and storm protection; and cultural services such as recreation, and aesthetics. Individual livelihoods and community viability will depend on the success of long-term efforts to restore natural ecosystem functions, native species, and natural structure (e.g., channels, islands, and shoreline). Quantifying and valuating ecosystem services will provide information that is critical in assessing tradeoffs and the consequences of alternative restoration actions. Their valuation will link directly to effective adaptive management restoration methodologies promoting conservation efforts, sustainable economic development and community resilience. Specific components of a comprehensive ecosystem services assessment include:

- Developing assessments of the value derived from, and risks to, Gulf coastal ecosystems, in order to better understand the risks of off-shore petroleum development;
- Identifying degraded and missing ecosystem services and prioritizing restoration efforts toward missing or impaired functions;
- Developing integrated models linking biological, hydrological, and physical data with ecosystem services;
- Delineating the social values derived from ecosystem services, thus prioritizing areas for restoration, including understanding the impacts of the oil spill on commercial, recreational, and subsistence fishermen;
- Combining valuation maps with hazard probabilities to characterize the risks associated with oil spills from existing and future oil development; and

- Modeling the probability of oil from any given well encountering various marine and coastal ecosystems.

OTHER ISSUES

Transport, fate, and potential impacts of oil and dispersants

The use of chemical dispersants has added to the challenge of understanding the fate and transport of oil (along with the dispersant) in the Gulf of Mexico region. Chemical dispersants have converted the oil into microscopic water-soluble droplets, facilitating their movement away from the surface oil slick and into the water column to the seafloor. This procedure results in potential impacts not only to surface and shore biota but also to the vast ecosystems that reside beneath the surface of the Gulf of Mexico. To understand these impacts, the USGS will address the fate and transport of not only oil and dispersant but also the mixture of oil and dispersant to determine their impact on coastal and marine ecosystems, such as wetlands, estuaries, reef communities, beaches, and the associated species that reside in these critical habitats.

Deep-water coral sampling

The USGS, in collaboration with the MMS, NOAA, and other agencies, has been conducting research on a variety of deep-sea and outer shelf habitats in the Gulf of Mexico for more than a decade. The comprehensive data archive, diverse skills, and technical capabilities of this group are ideal for investigating the impacts of the Deepwater Horizon oil spill on deep-water coral ecosystems in the Gulf of Mexico. The September 2010 research cruise, part of the USGS DISCOVRE (Diversity, Systematics, and Connectivity of Vulnerable Reef Ecosystems) expedition and scheduled prior to the spill, would be the basis for short- and long-term studies that would begin with the collection of sediment and bacterial community samples. Samples such as these would allow for a comparison of the pre-spill habitat to the post-spill habitat to measure the effect of contaminants on these deep-water coral ecosystems.

Use of Sand Berm/Barrier

The State of Louisiana requested emergency authorization on May 11, 2010, to perform spill mitigation work on the Chandeleur Islands and also on all the barrier islands from Grand Terre Island eastward to Sandy Point to enhance the capability of the islands to reduce the movement of oil from the Deepwater Horizon oil spill to the marshes. The proposed action, building a barrier berm (essentially an artificial island fronting the existing barriers and inlets) seaward of the existing barrier islands and inlets, “restores” the protective function of the islands but does not alter the islands themselves. Building a barrier berm to protect the mainland wetlands from oil is a new strategy and depends on the timeliness of construction to be successful. Because of the scope of this strategy, there are concerns about the availability of sufficient sand resources, the impacts of depleting these resources

and the possible negative effects to existing ecosystems. Prioritizing areas to be bermed, focusing on those areas that are most vulnerable and/or where construction can most rapidly be completed may increase chances for success.

The USGS recommends long-term monitoring of the berm to determine its performance and possible impacts on or benefits to the surrounding environment. Repeated surveys to update bathymetry, topography, sea bed characteristics and sea-bed images, along with sediment sampling, should be done to document changes through time. The observations and analyses will provide data needed to identify movement of oil and oil-degradation through the system, determine impacts, and identify the processes involved. For example, monitoring changes in barrier topography, and bathymetry along with analyses of sediment cores and oil-residue changes will show linkages between oil mobilization and sedimentary processes. Monitoring turbidity and salinity within the back-barrier environment will provide information on estuarine health.

CONCLUSION

The USGS will continue to work closely with other Department of the Interior and other Federal and State agencies as well as the private sector in response to the Deepwater Horizon oil spill. The USGS Environmental Incident Science Team is leading the effort to develop a plan to identify the Department's long-term research needs in the aftermath of this disaster. As we move from response to recovery, the DOI Bureaus will provide our best efforts to inform and guide decisions. I want to thank the Subcommittee for its support for USGS science. Without your recognition of the importance of USGS long-term monitoring and data collection, the USGS would not have the tools, data, and information that have allowed our rapid response to this crisis, and our Nation would not have the science necessary to begin its recovery from this tragedy.

Thank you for the opportunity to testify before you today. I will be pleased to answer any questions that you may have.