

**WRITTEN STATEMENT OF  
TONY PENN  
DEPUTY CHIEF, ASSESSMENT AND RESTORATION DIVISION  
OFFICE OF RESPONSE AND RESTORATION  
NATIONAL OCEAN SERVICE  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
U.S. DEPARTMENT OF COMMERCE**

**HEARING ON  
ASSESSING NATURAL RESOURCE DAMAGES RESULTING FROM THE BP  
DEEPWATER HORIZON DISASTER**

**BEFORE THE  
SUBCOMMITTEE ON WATER AND WILDLIFE  
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS  
U.S. SENATE**

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Thank you, Chairman Cardin and Members of the Subcommittee, for the opportunity to testify on the Department of Commerce's National Oceanic and Atmospheric Administration's (NOAA) role in the assessing natural resource damages resulting from the Deepwater Horizon BP oil spill.

My name is Tony Penn and I am the Deputy Chief of the Assessment and Restoration Division within NOAA's Office of Response & Restoration. I appreciate the opportunity to discuss the critical roles NOAA serves during and following oil spills and the importance of our contributions to protect and restore the natural resources, communities, and economies affected by this tragic event. Before I discuss NOAA's efforts, I would first like to express my condolences to the families of the eleven people who lost their lives in the explosion and sinking of the Deepwater Horizon platform.

NOAA's mission is to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs. NOAA is also a natural resource trustee and is one of the federal agencies responsible for protecting, assessing, and restoring the public's coastal natural resources when they are impacted by oil spills, hazardous substance releases, and impacts from vessel groundings on corals and seagrass beds. As such, the entire agency is deeply concerned about the immediate and long-term environmental, economic, and social impacts to the Gulf Coast and the Nation as a whole from the Deepwater Horizon BP oil spill. NOAA is fully mobilized and working tirelessly to lessen impacts on the Gulf Coast and will continue to do so until the spill is controlled, the oil is cleaned up, the natural resource damages are assessed, and the restoration is complete.

My testimony today will discuss NOAA's role during oil spills and the natural resource damage assessment (NRDA) process, who the natural resource trustees are for the Deepwater Horizon BP oil spill and how NOAA is working with our co-trustees; NRDA efforts underway; and future activities to provide for protection and restoration of natural resources. .

## **NOAA'S ROLES DURING OIL SPILLS**

NOAA has three critical roles mandated by the Oil Pollution Act of 1990 and the National Contingency Plan:

1. During the emergency response, NOAA serves as a conduit for scientific information to the Federal On-Scene Coordinator. NOAA provides trajectory predictions for spilled oil, conducts overflight observations of oil on water, identifies highly valued or sensitive environmental areas, and conducts shoreline surveys to determine clean-up priorities.
2. As a natural resource trustee, NOAA conducts a joint Natural Resource Damage Assessment (NRDA) with co-trustees to assess and restore natural resources injured by the oil spill. NRDA also assesses the lost uses of those resources, such as recreational fishing, canoeing, and swimming, with the goal of implementing restoration projects to compensate the public for these injuries.
3. Finally, NOAA represents the Department of Commerce in spill response decision-making activities through the National Response Team.

### ***Response***

The U.S. Coast Guard (USCG) is the Federal On-Scene Coordinator and has the primary responsibility for managing coastal oil spill response and clean-up activities in the coastal zone. During an oil spill, NOAA's Scientific Support Coordinators deliver technical and scientific support to the USCG. NOAA's Scientific Support Coordinators are located around the country in USCG Districts, ready to respond around the clock to any emergencies involving the release of oil or hazardous substances into the oceans, shorelines and related areas. Currently, NOAA has all of its Scientific Support Coordinators around the country working on the Deepwater Horizon oil spill.

With over thirty years of experience, NOAA continues to serve the Nation by providing its expertise and a suite of products and services critical for making science-based decisions. Examples include trajectory forecasts on the movement and behavior of spilled oil, overflight observations, spot weather forecasts, emergency coastal survey and charting capabilities, aerial and satellite imagery, and real-time coastal ocean observation data. Federal, state, and local entities look to NOAA for assistance, experience, local perspective, and scientific knowledge. NOAA's Office of Response and Restoration (OR&R) was called upon for scientific support 200 times in 2009 for issues related to oil and hazardous substance spills.

### ***Natural Resource Damage Assessment (NRDA)***

NRDA is a legal process to determine the type and amount of restoration needed to compensate the public for harm to natural resources and their human uses that occur as a result of an oil spill. Stewardship of the Nation's natural resources is shared among several federal agencies, states, and tribal trustees that conduct NRDA's. NOAA, acting on behalf of the Secretary of Commerce, is the lead federal trustee for many of the Nation's coastal and marine resources, and is authorized by the Oil Pollution Act of 1990 to recover damages on behalf of the public for

injuries to trust resources resulting from an oil spill. The Oil Pollution Act encourages compensation in the form of restoration. The appropriate type and amount of compensation is determined through the NRDA process.

NRDA in NOAA is conducted by the Damage Assessment, Remediation and Restoration Program (DARRP). Established in 1990 after the Exxon Valdez oil spill, DARRP is composed of a team of scientists, economists, restoration experts, and attorneys to assess and restore injured resources. Since 1990, NOAA, together with other federal, state, and tribal co-trustees have recovered over \$500 million for restoration of natural resources injured by oil, hazardous substances and vessel groundings. NOAA works cooperatively with co-trustee agencies and (in the case of a cooperative assessment of injuries) the responsible party (or parties) to share data and information collected during the spill and during the injury assessment. Working cooperatively with the responsible party and co-trustees can save time and money and can result in restoration being implemented faster and more efficiently.

Although the concept of assessing injuries may sound relatively straightforward, understanding complex ecosystems, the services these ecosystems provide, and the injuries caused by oil and hazardous substances takes time – often years. The time of year the resource was injured, the type of oil or hazardous substance, the amount and duration of the release, and the nature and extent of clean-up are among the factors that affect how quickly resources are assessed and restoration and recovery occurs. The rigorous scientific studies that are necessary to prove injury to resources and services may also take years to implement and complete. The NRDA process ensures an objective and cost-effective assessment of injuries – and that harm to the public's resources is fully addressed.

### ***National Response Team***

The National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan, is the federal government's blueprint for responding to both oil spills and hazardous substance releases. The purpose of the National Contingency Plan is to develop a national response capability and promote overall coordination among the hierarchy of responders and contingency plans. NOAA represents the Department of Commerce on the National Response Team and works closely with regional response teams and local area committees to develop policies on dispersant use, best clean-up practices, and communications, and to ensure access to science-related resources, data, and expertise.

## **NOAA's NATURAL RESOURCE DAMAGE ASSESSMENT EFFORTS**

Oil spills affect our natural resources in a variety of ways. They can directly impact our natural resources, by oiling marine mammals, for instance. They can diminish the ecological services an ecosystem can provide, such as the loss of critical nursery habitat for shrimp, fish, and other wildlife or the loss of floodwater protection resulting from an oil spill. Oil spills may also diminish how we use natural resources by affecting fishing, boating, beach going, and wildlife viewing opportunities.

### ***Natural Resource Trustees***

Trustees for the Deepwater Horizon oil spill includes NOAA, Department of the Interior's (DOI) U.S. Fish and Wildlife Service, DOI National Park Service, and the designated State trustee agencies for the states of Texas, Louisiana, Mississippi, Alabama, and Florida. The Deepwater Horizon oil spill NRDA will be conducted pursuant to the Oil Pollution Act (OPA) of 1990.

Natural resource trustee agencies are responsible for trust resources as designated by the National Contingency Plan (40 CFR § 300.600). The Secretary of Commerce (acting through NOAA) is a trustee for the following natural resources and their supporting ecosystems: marine fishery resources; anadromous fish; endangered species and marine mammals; and the resources of National Marine Sanctuaries and National Estuarine Research Reserves.

At the outset of the Deepwater Horizon oil spill, NOAA quickly mobilized staff from its DARRP to begin coordinating with federal and state co-trustees and the responsible parties to collect a variety of data that are critical to help inform the NRDA. Several technical working groups (composed of NOAA, federal and state co-trustees, and representatives from one responsible party (BP)) are gathering existing scientific information and developing and implementing baseline (pre-spill) and post-impact field studies for multiple resource categories. Resources being assessed include fish and shellfish, bottom-dwelling biota, birds, marine mammals, turtles, and sensitive habitats such as wetlands, submerged aquatic vegetation, beaches, mudflats, deep and shallow corals, and the water column, including bottom sediments. The trustees are also collecting and reviewing relevant water column, shoreline, wildlife and other data being collected as part of the response and by other entities. In addition, trustees are assessing potential adverse impacts from necessary response actions, including dispersant use at the surface and at depth. NOAA is coordinating co-trustee participation in most of the technical working groups and is providing scientific and technical expertise and information management to many parts of the overall NRDA effort.

While it is still too early in the process to know what the full scope of the damage assessment associated with the Deepwater Horizon oil spill will be, NOAA and co-trustees are concerned about potential short and long-term impacts to fish, shellfish, marine mammals, sea turtles, birds, and other sensitive resources, including impacts to their habitats, such as wetlands, beaches, bottom sediments, and the water column. These areas may include National Estuarine Research Reserves and National Marine Sanctuaries that may be impacted by the oil spill. The data collected in the Gulf of Mexico and across the five Gulf states (Texas, Louisiana, Alabama, Mississippi, and Florida) will be used to determine what natural resources have been injured and what human uses have been lost due to the spill.

### ***Data Collection Efforts***

NOAA research ships and contracted ships have been deployed to collect chemical and biological samples pre- and post-oiling. Additional baseline and injury assessment plans are now being implemented. Existing plans will be updated and others developed going forward to determine what resources are, have been, or could be exposed to oil. The information below provides an update on the cruises and data collections efforts for various sensitive resources and habitats. The data and information being collected will be used to determine how best to restore injured resources and develop the most appropriate restoration projects to compensate the public

for associated lost services. The information provided below outlines NOAA's cruises and data collection efforts for various sensitive resources and habitats.

### ***Water Column***

The purpose of the water column assessment is to document the persistence, fate, and transport of the oil in the water column and the resulting exposure of fish, shrimp, and other aquatic resources to this oil over time. Baseline (pre-oiling) water quality data for the coastal areas of the five Gulf states have been, and continue to be, acquired by the trustees. This includes water samples collected in near shore areas and from long-term monitoring sites from NOAA's Mussel Watch program.

Cruises aboard NOAA vessels, NOAA contracted vessels, and partner research vessels began in late April and have continued to gather data specific to the water column inside and outside of the oil slick. During these cruises, water samples were collected to analyze for the presence of oil and whether any oil recovered matched the Deepwater Horizon oil "fingerprint." Since the beginning of May, NOAA has been conducting and coordinating sampling of the sub-surface region around the Deepwater Horizon well-head and beyond to characterize the presence of subsurface oil. The sub-surface search involves the use of sonar, UV instruments called fluorimeters, which can detect the presence of oil and other biological compounds, submersible laser-scattering instruments to determine oil concentration and distribution, and collection of water samples from discrete depths using a series of bottles that can be closed around a discrete water sample.

NOAA, federal partners, academics, and others in the research community have mobilized to research and quantify the location and concentration of subsurface oil from the spill. NOAA Ships *Gordon Gunter*, *Thomas Jefferson*, *Nancy Foster*, *Delaware II*, and *Pisces* have conducted and continue to conduct missions to collect water samples from areas near the wellhead as well as further from the wellhead and in the coastal zone. Water samples from many of these missions are still being analyzed and additional missions are in progress or being planned to continue the comprehensive effort to define the presence of oil below the surface and understand its impacts. These and other data will be used to determine the presence of a submerged plume and to calibrate a three-dimensional model of the entire oiled area.

### ***Fisheries (Nearshore & Offshore) and Plankton***

In addition to the historical baseline data on fisheries assemblages in the Gulf of Mexico, cruises are collecting pre- and post-oiling data on fish and plankton resources. An initial cruise on the *R/V Weatherbird II* (a National Science Foundation vessel) in late April collected water and biota data from outside the oiled zone. A second cruise that started on May 4, 2010, collected data on living marine resources at 32 existing Southeast Area Monitoring and Assessment Program (SEAMAP) sites off of the Florida panhandle (as baseline) and 6 stations in the vicinity of the oiled area. In addition to sampling for adult and larval fish and plankton, water samples were collected to characterize oil droplet numbers and size in the vicinity of the plume. Samples were also taken to assess toxicity, stable isotopes, sediments, and bottom-dwelling biota.

The NOAA ship *R/V Gordon Gunter* has conducted a survey of fish larvae in the Gulf, and has also been deployed to use its sonar and fluorometry equipment to map the presence of

submerged oil. Water samples will be analyzed to confirm sonar readings. Cutting-edge technology developed by University of South Florida scientists, called the “SIPPER,” has been deployed to view microscopic marine life, such as zooplankton, fish eggs and larvae, as well as miniscule droplets of oil. The NOAA ship *Delaware II* has been deployed to gather data about the conditions of highly migratory species, e.g., tuna, swordfish, in waters around the Gulf of Mexico spill site. In addition, NOAA ships *Oregon II* and *Pisces* are deployed in the eastern and western Gulf of Mexico to conduct seafood and water quality testing and survey reef fish, bottom-dwelling fish, and shrimp species abundance.

### ***Oysters and Other Nearshore Benthic Biota and Habitat***

NOAA’s Mussel Watch Program quickly mobilized to sample shellfish, water, and sediments at 64 sites in the Gulf of Mexico, ranging from the Brazos River in Texas eastward to the Florida Keys, in order to establish baseline data before the oil hit the shoreline. These samples will be analyzed for 60 oil-related compounds known as polycyclic aromatic hydrocarbons (PAH). Oil from the Deepwater Horizon oil spill has a unique chemical “fingerprint” of constituent PAHs and other compounds that will allow Mussel Watch researchers to distinguish contamination from this spill from oil coming from other sources. Once the oil hits the shoreline, new samples will be taken and tested. Additional sampling plans are being developed for Northern Gulf Coast oyster beds and sea grass habitat to document exposure to and presence of petroleum hydrocarbons and to evaluate and identify adverse effects to these resources.

### ***Shoreline Habitats***

NOAA is currently working with other resource trustees to document the shoreline habitats (e.g., beaches, mudflats, mangroves, wetlands) that have been, are being, or could be exposed to the oil. Trustees are working to assess pre- and post-oiled shorelines, and to document the spatial extent and degree of oiling on intertidal shoreline habitats. As the oil contacts the shoreline, aerial imagery has been used to identify priority response initiatives and vulnerable habitat and to provide up-to-date information on the location of the oil. Between 4 and 7 shoreline survey teams are in the field daily. Information from these efforts is being used to produce maps to detail the extent of shoreline oiling over time and to identify stations for potential use in future injury-assessment studies.

### ***Other Resource and Habitat Assessment Efforts***

In addition to the work described above, additional assessment efforts are being conducted by the co-trustees to determine what resources are, have been, or could be exposed to oil for the following categories:

- **Submerged Aquatic Vegetation:** Several co-trustee teams are in the field daily to assess potential impacts to sea grass habitat and other submerged vegetation and document potential presence of and exposure to petroleum hydrocarbons and dispersants from discharged and dispersed oil.
- **Birds:** Work plans to assess baseline conditions of pelagic, colonial marsh, and other birds are in place. Bird survey teams continue to survey beaches for birds in Florida, Alabama, and Mississippi. Work plans to assess post-oiling impacts to birds are underway.

- **Marine Mammals and Turtles:** The trustees continue to conduct marine mammal and turtle aerial surveys by fixed-wing planes and helicopter to document exposure, acute effects, and potential changes in behavior or distribution. In addition, co-trustees are conducting vessel based surveys of protected marine mammals in near-shore, e.g., dolphins and manatees, and deep water habitats, e.g. sperm whales.
- **Deep-water benthic habitat:** Trustees are compiling existing data and information about the deep-water benthic communities, as well as any information about their sensitivity to dispersed oil. More formal assessment plans to document pre- and post-oiling conditions are being executed for deep water benthic communities in the vicinity of the mc252 well. For example, a major ongoing deepwater coral study funded by Minerals Management Service and NOAA's Office of Ocean Exploration and Research is being utilized for an initial Tier 1 NRDA impact assessment of deep coral and chemosynthetic community habitats. This study includes invaluable pre-spill baseline imagery and active *in situ* experiments.
- **Shallow-water corals:** Trustees are compiling existing data and information about the deep- and shallow-water coral communities, as well as any information about their sensitivity to dispersed oil. More formal assessment plans to document pre- and post-oiling conditions are being developed to examine and document potential exposure, acute effects, and potential changes to coral reef communities in the FL keys, Dry Tortugas, and FL middle grounds.
- **Terrestrial Wildlife:** Appropriate information about terrestrial wildlife communities – for example, deer, rabbits, quail, and turkeys – and information about their sensitivity to oil is being collected, and a more formal assessment protocol is under development.
- **Human Use:** NOAA and co-trustees are collecting existing information about human uses, including cultural uses. Field teams are conducting user intercept surveys from Louisiana to Florida. Overflights are being used to gather beach use information along the Gulf Coast.

### ***Sampling and Data Management***

For all the efforts listed above, NOAA, the co-trustees, and the responsible party have agreed to a data workflow process so that samples collected for analytical chemistry follow the same means of tracking, chain of custody, quality assurance/quality control, and data delivery into a unified database for analysis. NOAA, in coordination with DOI and other federal agencies, is providing geospatial support through the Environmental Response Management Application (ERMA). ERMA is a web-based Geographic Information System tool designed to assist both emergency responders and environmental resource managers who deal with events that may adversely impact the environment. ERMA is serving as a tool for coordinating information across the response teams and providing a common operational picture. Because of the demand for this capability, NOAA recently released a public version of ERMA. The ERMA website (<http://www.geoplatform.gov/>) allows the public timely access to information cleared by the Unified Command.

## **ACTIVITIES TO IMPROVE FUTURE RESPONSE AND RESOURCE ASSESSMENT EFFORTS**

The Deepwater Horizon oil spill is a grave reminder that spills of national significance can occur despite the many safeguards and improvements that have been put into place since the passage of OPA. Although the best option is to prevent oil spills, the risk of oil spills remains a concern given the offshore and onshore oil infrastructure, pipes, and vessels that move huge volumes of oil through our waterways. If a spill does occur, responders must be equipped with the appropriate tools and information. An effective response, based on solid science and smart decision-making reduces environmental and socioeconomic impacts, as well as clean-up costs. Research and development and technological innovation by the public or private sector in the following areas would greatly enhance the tools and technologies available in the event of a spill.

- ***Oil Fate and Behavior from Deepwater Releases***

Our ability to know where the oil is located is limited by what we can see and detect. As the Deepwater Horizon oil spill is demonstrating, there is a need to understand how oil behaves and disperses within the water column when released at deep depths. The emerging advancement in modeling three dimensionally can greatly enhance response operations and mitigation efficacy. NOAA's surface trajectory models predict where the oil on the surface is going based upon wind, currents, and other processes, and visual overflights validate where it is now. NOAA is currently employing facets of deep water oil spill models that were developed in part from the findings of the MMS DeepSpill Joint Industry Research Project done in 1999-2000 with international participation. However, we still understand little about the movement of oil deep in the ocean or the movement of dispersed oil that is suspended in the water column. The enhancement of three dimensional models will improve our ability to predict the movement of oil at depth and allow us to direct precious resources to validate the model's accuracy. Currently, NOAA is working to implement FY 2010 funds to enhance three-dimensional models.

- ***Technology for Oil Detection in the Water Column and on the Seafloor***

Research on new technologies for rapid and accurate detection of oil in deep water and plumes in the mid-water is needed. This would include the development of technologies to enhance our understanding of the fate and transport of oil, and to better understand the effects of oil on benthic habitat. There also appears to be some utility in applying existing technologies in a new and unique way to reach these same goals. For example, in limited research applications, modern multibeam echo sounders have been able to detect oil in the water column and on the seafloor. In addition, sensors on autonomous underwater vehicles and gliders are capable of detecting the presence of oil and gas in the water column. Whether provided by new technologies, or through re-examining the capabilities of current technologies, highly accurate information on the precise location of spilled oil would be of significant benefit to a spill response, such as Deepwater Horizon oil spill. Timely understanding of the precise location of the spilled oil would allow responders to position their activities and better utilize limited resources to maximize our contributions to protect and restore the resources, communities, and economies affected by these tragic events.

- ***Surface Observations and Trajectory Models***

Real-time data on currents, tides, and winds as well as sustained observations of physical and chemical parameters of the whole water column are important in driving the models that inform the trajectory forecast for the spilled oil. As the Integrated Ocean Observing System generates more data from technological advances like high frequency radar, the prediction of oil location can be improved by pulling these observations into trajectory models quickly. Through the collaborative efforts of the U.S. Integrated Ocean Observing System (IOOS), two of the three radars along the northern Gulf of Mexico coast were quickly re-established and made operational and now all three are delivering surface current data. Because we cannot predict where a spill will occur, data delivery from high frequency radars is envisioned to be part of a seamless national system.

Data collected by space-based synthetic aperture radar can be used to produce high resolution images of the Earth's lands and oceans and can also be used in all types of weather, as it can "see through" clouds and darkness. Current use of NOAA-generated experimental products suggest that data from space-based synthetic aperture radar can assist in detecting and refining the areal extent of oil, which would provide valuable information to help determine where response efforts and resources should be deployed.

Current hydrographic surveys carry out sustained observations of the whole water column in the Gulf of Mexico, Florida Bay, and Florida Keys, and will be extended if the oil or dispersant spread through the Strait of Florida and into the Gulf Stream. These surveys, along with satellite observations and numerical models, allow monitoring of currents and features responsible for the transport of oil and dispersant. A sustained observing system for this region would allow NOAA to provide predictive information about how the spill may impact the East Coast of the United States.

- ***Long-Term Effects on Species and Habitats***

Spilled oil can remain in the sediments along the shoreline and in wetlands and other environments for years. More than twenty years later, there are still toxic levels of sub-surface oil in Prince William Sound from the Exxon Valdez spill. Research is needed to improve our understanding of the long-term effects of oil on sensitive and economically important species and habitats. Continued research is also needed to determine the effects of oil and dispersants that are suspended in the water column on pelagic species, as well as research on the effects of oil on deep water corals, chemosynthetic communities (animal communities living in the deep sea on dissolved gases and benthic habitats) and benthic habitats. Important interagency studies are currently underway that will provide valuable information on the sensitivity and resilience of these deepwater communities, and will inform response actions.

- ***Data Management Tools for Decision Making***

The key to effective emergency response is efficiently integrating current science, information technology, and real-time observational data into response decision-making. NOAA has developed the Emergency Response Management Application (ERMA), a web-based information management application, to facilitate preparedness, response, and restoration decision-making for oil spills and for other coastal hazards. ERMA integrates

observations (e.g., NOAA National Buoy Data Center data, weather data, shoreline data, vessel traffic information, etc.) with archived data sources (e.g., NOAA's National Oceanographic Data Center's historical data) in an easy to use, Google-based format to aid in evaluating resources at risk, visualizing oil trajectories, and planning rapid tactical response operations, injury assessment and habitat restoration. Having access to retrospective data is critical to bring value to real-time observational data being collected. NOAA is working with the Department of Interior DOI and state trustees to assure that data management tools can be integrated.

NOAA is currently using the Gulf of Mexico ERMA for the Deepwater Horizon oil spill response to help manage the common operational picture for all command posts (<http://www.geoplatform.gov/gulfresponse/>). The Gulf of Mexico ERMA is updated daily to provide a dynamic and automated tool allowing for greater access, more layers of data, and high-resolution photography. ERMA allows users to navigate through different layers of information to reveal actual data and magnify areas of geographic interest – ultimately improving decision making. In addition to the Gulf of Mexico, ERMA is operational in the U.S. Caribbean and New England.

- ***Natural Resource Protection Tools***

Environmental Sensitivity Index (ESI) database and map products provide information that helps reduce the environmental, economic, and social impacts from oil and hazardous substance spills. ESI maps include information on biological resources (such as birds, shellfish beds, and endangered species), sensitive coastal and nearshore habitats (such as marshes, tidal flats, and sea grass beds, National Estuarine Reserves and National Marine Sanctuaries), and human-use resources (such as public beaches, parks, and drinking water intakes). ESI maps are one tool that spill responders can use to identify priority areas to protect from the spreading oil, develop cleanup strategies to minimize impacts to the environment and coastal communities, and reduce overall cleanup costs. NOAA's goal is to update ESI maps approximately every 10 years to ensure responders have up-to-date information.

- ***Research to Improve Tools for Assessment and Restoration***

Current techniques to assess and restore injured natural resources need to be constantly updated and refined. As our understanding of complex ecosystems evolves, so should our modeling tools and restoration techniques. For example, currently, site-specific protocols for assessing injuries to unique, high-value habitats such as those found in the Arctic are needed. In addition, research and tools to better assess and quantify natural resource services — such as water filtration and capture, flood protection, carbon sequestration, recreation, and education — across a range of habitat types can help ensure the public is fully compensated and the environment is fully restored.

- ***Air Quality Impacts***

In addition to its marine responsibilities, assists in predicting the air quality impacts from oil and hazardous substance spills. The characteristics of pollution released from large areas of burning oil and the widespread evaporation of oil are significantly different from routine air quality/atmospheric dispersion scenarios. Research and development of

improved tools to estimate the characteristics of compounds entering the atmosphere, and integration of those tools with NOAA's existing atmospheric modeling capabilities, would significantly improve NOAA's ability to predict smoke and chemical concentrations in the atmosphere resulting from such incidents.

- ***Oil in Arctic Environments***

Continued acceleration of sea-ice decline in the Arctic Ocean as a consequence of global warming may lead to increased Arctic maritime transportation and energy exploration that in turn may increase the potential of oil spills in the Arctic. Recent studies, such as the Arctic Monitoring and Assessment Programme's Oil and Gas Assessment, indicate that we currently lack the information to determine how oil will behave in icy environments or when it sinks below the surface. We also lack a basic understanding of the current environmental conditions, which is important for conducting injury assessments and developing restoration strategies. Research is needed to better understand the challenges of spill response in Arctic waters and the most effective tools and techniques to utilize in such environments.

- ***Human Dimensions***

Research is needed on how to incorporate impacted communities into the preparedness and response, restoration and recovery processes to help to address the human dimensions of spills, including social issues, community effects, risk communication methods, and valuation of natural resources. Transparency and communications can be improved to share information with impacted communities on how and why decisions are made, and the breadth of response and NRDA activities that have been and will be undertaken for the Deepwater Horizon oil spill.

## **CONCLUSION**

I would like to assure you that we will not relent in our efforts to protect the livelihoods of Gulf Coast residents and mitigate the environmental impacts of this spill. In the wake of such an event, we are reminded of the fragility of our coastal ecosystems and the dependence of coastal economies on the health and prosperity of our seas. Thank you for allowing me to testify on NOAA's response and damage assessment efforts. I am happy to answer any questions you may have.