Gulf of Mexico
Environmental Recovery and Restoration



Five Year Report | March 2015

Contents

NOTE: This report was prepared by BP Exploration & Production Inc. For ease of use, this report refers to BP Exploration & Production as BP.

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The natural resource trustees, their representatives and the federal and state agencies that are assessing the condition of natural resources have additional data, analysis and views that are not available to BP, or are not reflected in this report. Such information may be included in the trustees' final Natural Resource Damage Assessment and Restoration Plan for the Deepwater Horizon accident. More information about the trustees' work can be found at www.gulfspillrestoration.noaa.gov and on other federal and state websites.

This report seeks to provide the reader with an overview of information about the Gulf environment, including information reported by the trustees and by third parties. References to publications by the trustees and third parties are included for informational purposes only and should not be interpreted as an indication that BP agrees with the data or contents of those publications. Citations to those publications are included in the endnotes of this report.

Message from BP:

Five years of investigation: the Gulf of Mexico is rebounding

Five years have passed since the tragic events of April 20, 2010, when 11 men lost their lives aboard the Deepwater Horizon drilling rig. In the aftermath of the accident, BP Exploration & Production Inc. (BP) and federal, state and local agencies launched an extraordinary response effort to cap the well, capture and remove oil from the water and minimize impacts. Still, oil escaped into the sea for 87 days, affecting some wildlife and habitats.

To begin to understand the environmental impact, within days of the accident BP and government scientists were in the field evaluating the potential for injury to wildlife and habitats, as well as lost recreational use of these resources.

So began the Natural Resource Damage Assessment (NRDA) – the largest such environmental assessment ever performed. To date, NRDA scientists have conducted more than 240 studies, and BP has spent about $1.3 billion to pay for them. The assessment is still underway.

In addition to the NRDA work, scientists working on the spill response performed environmental studies to help guide cleanup operations. This included government studies conducted by multi-agency Operational Science Advisory Teams (OSAT).

The NRDA and OSAT studies have produced a vast amount of data on the Gulf's condition before, during and after the accident. This information is helping scientists understand the environmental impact and recovery thus far.

The science is showing that most of the environmental impact occurred immediately after the accident – during spring and summer 2010 – in areas near the wellhead and along oiled beaches and marshes. Areas that were affected are recovering and data BP has collected and analyzed to date do not indicate a significant long-term impact to the population of any Gulf species.

Several key factors mitigated the accident's environmental impact: the location in deep water, far offshore and in a temperate climate; the type of "light" crude oil involved, which degrades and evaporates faster than other oils; the massive offshore response and shoreline cleanup effort; and the natural resilience of the Gulf's ecosystems.

In early 2014, the U.S. Coast Guard ended active shoreline cleanup, and today injured natural resources are being restored. BP entered an unprecedented agreement in 2011 to provide up to $1 billion for early restoration projects, allowing environmental restoration work to begin while scientists continued to assess injury through the NRDA. At the end of 2014, 54 projects costing about $700 million were underway across Alabama, Florida, Louisiana, Mississippi and Texas.

The hard work of tens of thousands of people – both inside and outside of BP – has resulted in significant progress toward understanding the accident's environmental impact, cleaning the shoreline and restoring the Gulf. This report summarizes what BP has done and learned, and is part of our pledge to keep the public informed about progress in the Gulf. Also, data from NRDA and response scientific studies are available at http://gulfsciencedata.bp.com.

We hope the information will help provide a better understanding of the Gulf's ecosystems five years after the accident, and the actions BP has taken to meet its commitment to restore the environment.

Laura W. Folse
Executive Vice President
Response and Environmental Restoration
BP Gulf Coast Restoration Organization

Environmental conditions in the Gulf

Extensive water and sediment data that government agencies and BP collected in the field show that the vast majority of the Gulf did not experience harmful exposures to oil or dispersant components.

Government agencies and BP have an enormous volume of environmental data on oil and dispersant exposure and toxicity in the Gulf. Water and sediment samples were collected at more than 10,000 locations during and after the Deepwater Horizon accident. Data from these field samples provide the basis for understanding potential impacts.

Analysis of this publicly available data show that there were no harmful exposures to oil or dispersant compounds in the vast majority of the area investigated. The few areas where there were potentially harmful exposures were limited in space and time, mostly in the area very close to the wellhead during the spring and summer of 2010.[1] The data also show:

- Less than 2 percent of the nearly 18,000 water samples had concentrations of oil-related chemicals that exceeded the U.S. Environmental Protection Agency's (EPA) water toxicity benchmarks for aquatic life. Samples that exceeded benchmarks were largely limited to the area very close to the wellhead. After the well was capped on July 15, 2010, the percentage of samples exceeding the EPA benchmarks dropped dramatically.
- Of the more than 8,000 water samples analyzed for dispersant chemicals, only 16 (0.3 percent) exceeded the EPA aquatic life benchmarks for dispersant chemicals.
- Fewer than 2 percent of the more than 8,000 sediment samples collected exceeded the EPA sediment toxicity benchmark for aquatic life, and these were largely limited to the area close to the wellhead.
- More than 4,000 sediment samples were analyzed for dispersant-related chemicals. More than 90 percent of the samples had no detectable dispersant markers, and only a single sample had levels elevated above background concentrations.
- Most of the water sampling was done in areas where scientists expected oil concentrations to be the highest. This sampling bias means the data likely overestimate the actual exposure in the Gulf.

Scientists collect water samples near Bayou La Batre, Ala. in August 2010.

Key factors that lessened the spill's impact

The spill's location, the large-scale response operation and the Gulf's natural processes limited injury by causing the volume and concentrations of oil to decrease as the oil moved farther away from the well.

Location was in deep water, far offshore and in a warm climate

The accident occurred more than 40 miles from the nearest shore, about 5,000 feet below the water surface and in a temperate climate. Both the velocity at which the oil was released from the Macondo well and the application of chemical dispersants at the wellhead caused much of the oil to break into small droplets.

This increased the rate that the microbes biodegraded the oil.[2] Once oil reached the surface, warm water temperatures helped accelerate evaporation.[3]

A substantial quantity of oil dissolved, evaporated, biodegraded, photo-oxidated (chemical reactions caused by exposure to sunlight) or was cleaned up as it traveled from the wellhead to the surface and then the shoreline.

As a result, most of the Gulf's shoreline remained free of oil. Of the more than 16,000 Gulf shoreline miles, including bays and inlets,[4] surveys by assessment teams found that about 1,100 miles had some level of oiling, with most of it characterized as light, very light or trace.

Oil that reached the shoreline had undergone significant physical and chemical changes and contained only a small fraction of the compounds of concern.[5]

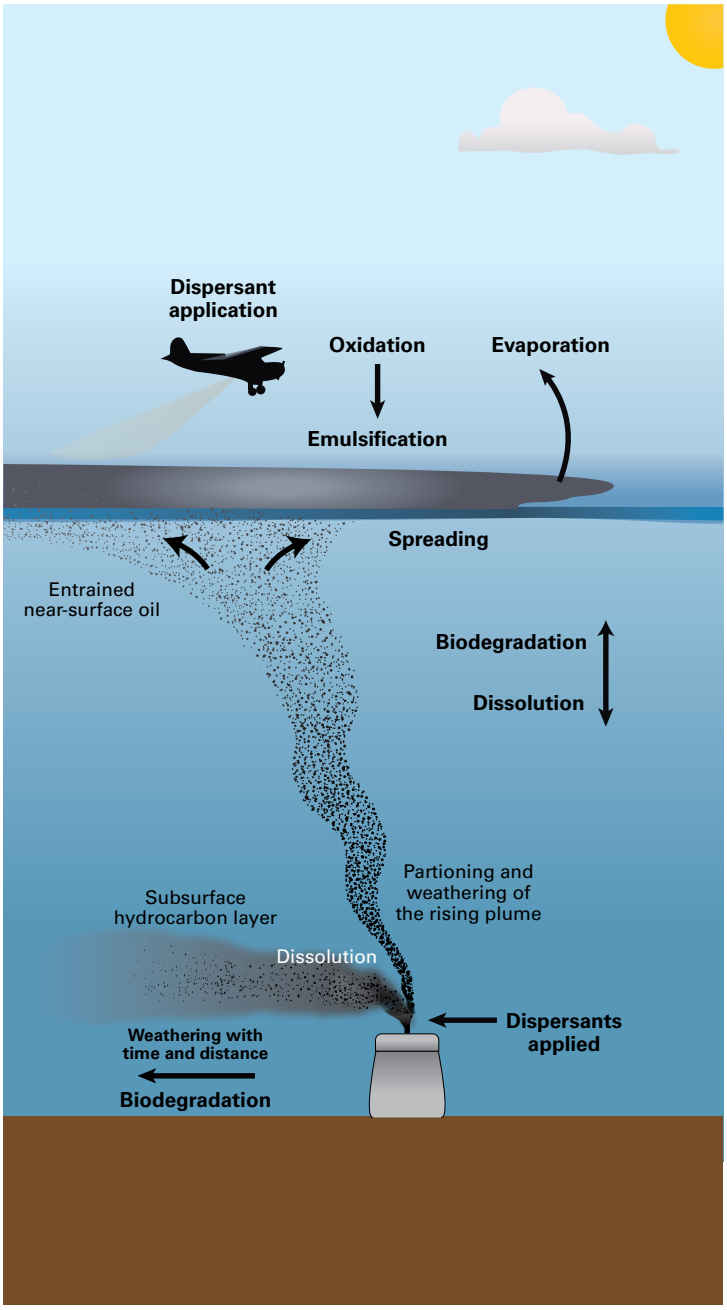
Oil was "light crude"

Oil released during the accident was a "light" crude, which degrades, dissolves and evaporates faster than other crude oils such as the heavier oil from the 1989 *Exxon Valdez* spill.

The lighter the oil, the less dense it is and the faster it typically biodegrades.[6] Studies have indicated that the oil from the Macondo reservoir experienced fairly rapid biodegradation, even in the deep sea where the water is cold.[7]

Macondo oil also is not as dense as seawater. In 2010, the government noted, "extensive laboratory study has shown that this particular oil will not sink" unless it combines with other materials such as sediments.[8]

Highly simplified depiction of transport and fate of oil



The oil was released at the sea bottom and far from shoreline habitats. Weathering and degradation occurred rapidly, reducing the oil's volume and toxicity.

Response facts

$14.3 billion
spent on response (source control and cleanup)

70+ million
personnel hours devoted to these efforts

100,000+ people
have worked on the response

6,500 vessels
utilized at the peak in 2010

4,379 miles
of shoreline were ground-surveyed by assessment teams

1,096 miles
had some level of oiling, with most categorized as either light, very light or trace

776 miles
had some measure of manual or mechanical cleaning recommended

Response workers place protective boom in Bon Secour Bay, Ala. in May 2010.

Response and cleanup was significant

The unprecedented response BP launched – under the Coast Guard's direction and in coordination with other federal and state agencies – was highly effective at minimizing the amount of oil that reached the Gulf shoreline. A variety of techniques were used offshore:

- Containment systems were installed at the wellhead to collect and send oil to surface vessels.
- Dispersants were applied at the surface and wellhead to help break the oil into small droplets that natural processes could break down more quickly.
- Oil in open water was contained in fire-resistant boom and removed through controlled burning.
- About 13.5 million feet of boom were deployed to act as temporary floating barriers to contain and absorb oil.
- Mechanical skimming devices were used to remove oil from the water surface.

Despite these efforts, some weathered oil still reached the shoreline and was recovered through extensive cleanup operations. In some areas, it was determined through net environmental benefit analyses that cleanup activities would cause more harm to the environment than leaving the material in place.

Early on, the cleanup focused on bulk material removal. Specific treatment plans were then developed and implemented for each shoreline area, which helped minimize environmental impacts from cleanup operations.

- Public beaches were generally cleaned to depths of up to five feet using mechanical equipment that sifts out residual oil and other debris from below the beach surface while returning clean sand to the beach.
- Non-recreational beaches were generally hand-cleaned to depths of up to six inches, but deeper if warranted.
- Multiple techniques were used to treat some oiled marsh areas. However, based on science and experience, marsh experts determined that invasive marsh cleanup operations could do more harm than good in most cases. Therefore, most oiled marsh areas were allowed to recover naturally.
- About 200,000 auger holes, trenches and pits were dug to locate and recover residual oil that had mixed with sand and other material and become buried in nearshore areas. No oil was observed in 67 percent of these subsurface tests.

- Crews regularly patrolled many areas on foot and recovered material when it was found.

BP also worked with government agencies to coordinate one of the largest-ever wildlife protection efforts. Wildlife experts worked to rescue, rehabilitate and release affected birds, sea turtles and marine mammals.

The Coast Guard ended active cleanup operations in Alabama, Florida and Mississippi in mid-2013 and in Louisiana in April 2014. All shoreline areas were transitioned back to the Coast Guard's National Response Center (NRC) reporting system. The NRC is the national point of contact for reporting oil discharges into the environment anywhere in the U.S. and its territories. The Coast Guard investigates reports of oil and identifies the source.

BP will respond at the Coast Guard's direction if the NRC process identifies additional Macondo oil that requires removal.

The Gulf's environment is naturally resilient

History shows that Gulf species are resilient and their populations can adapt and rebound from environmental disturbances. While some individual members of a population may be harmed by environmental change, often not enough are lost to cause an impact to the overall health of the population.

Even when manmade or natural events have caused a population-level impact, Gulf species have shown the ability to rebound. For example, the use of DDT in the 1950s and 1960s decimated brown pelican populations. But after the chemical was banned, brown pelican populations increased.[9] Brown pelicans recovered in much of the same way after Hurricanes Katrina and Rita severely damaged their habitat in 2005 and caused brown pelican populations to drop significantly.[10]

Over millions of years, Gulf ecosystems also have adapted to consume and biodegrade oil released by the many natural oil seeps across the sea floor. The National Resource Council estimates that 560,000 to 1.4 million barrels of oil seep naturally into the Gulf every year,[11] and some studies estimate even higher rates.[12] When the amount of oil in the environment increases, microbe communities also increase in size.

The authors of a 2011 scientific paper stated, "In the Gulf of Mexico the microbiota are likely to be better adapted to oil because of natural seeps and offshore drilling then almost anywhere else in the world. Thus, it is not surprising that bacteria in the Gulf of Mexico responded rapidly to the influx of oil."[13]

A "PowerScreen" machine cleans an area of Orange Beach, Ala. and returns cleaned sand to the beach in 2010.

Fingerprinting oil

Because of the many sources of oil in the Gulf of Mexico – natural seeps, accidental discharges from vessels, pipelines, wells, etc. – rigorous forensic fingerprinting is necessary to determine the oil's origins. Since late 2013, Coast Guard testing of recovered material found in many instances that it was not Macondo oil.

Crude oil contains many organic compounds, including hydrogen, carbon and sulfur. Experts can detect distinct differences in the ratios of these compounds in oil from different sources, which distinguish one oil sample from another just as blood types, human fingerprints or DNA can be differentiated. Although oils change in chemical composition as they weather and degrade, it is usually in a predictable pattern that experts can fingerprint.

Sunset at a fishing pier in Grand Isle, La.

However, despite the Gulf's regenerative properties, natural and manmade stressors have affected the region's species and habitat for decades. These stressors, and the harm they have caused, must be taken into account when assessing the Gulf's pre-spill condition and the nature and extent of any injury from the spill.

- **Natural stressors** – These can include natural events such as hurricanes, droughts, freshwater flooding, extreme cold or heat, disease and pest infestations. Importantly, because of the significant amount of oil that seeps naturally into the Gulf every year, it is critical to distinguish between oil impacts from the accident and those from natural seeps.

- **Manmade stressors** – Coastal development, runoff from the Mississippi River and pollutants from regional industry, especially agriculture, affect the Gulf environment. For example, phosphorus and nitrogen from fertilizer, animal waste and wastewater are discharged into the Mississippi River and carried into the Gulf, creating a "dead zone" roughly the size of Connecticut.[14] In addition, overfishing of popular species has reduced fish population levels, and the accidental capture of non-targeted species has led to population declines for sea turtles and marine life.[15]

- **Coastal erosion** – For decades the Gulf states have experienced significant coastal erosion because of both natural processes and human activities such as levees and dredging. For example, Louisiana loses three million acres of wetlands a year, according to the U.S. Geological Survey.[16]

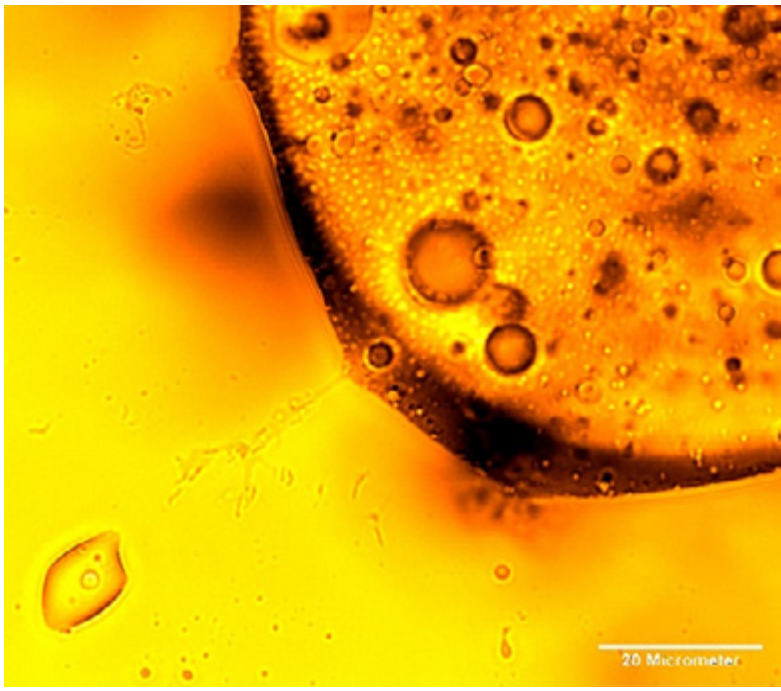
Microbes played important role

Scientific studies have shown that microbes biodegraded and consumed a significant amount of the Macondo oil that entered the water.

- Different microbes consumed different compounds in oil; as the composition of the oil changed, the mix of microbes also changed.[17]

- Biodegradation of oil also occurred in salt marshes[18] and in beach sands.[19]

- Laboratory studies suggest that microbes also degrade dispersant compounds.[20]



A water sample collected from the deep sea during the Deepwater Horizon accident shows bacteria interacting with a droplet of Macondo oil.[21]

Natural Resource Damage Assessment for the Deepwater Horizon accident

BP has been working with state and federal trustees through the NRDA process to collect data to evaluate injury to wildlife and habitat, and the recreational use of these resources.

The Oil Pollution Act of 1990 established the NRDA process. BP and the trustees use data collected through the process to evaluate injuries to natural resources and guide the selection of early restoration projects and the longer-term Gulf Coast restoration.

The goal is to return the environment to its baseline condition – how it would be if the Deepwater Horizon accident had not occurred. The NRDA identifies injuries resulting from the accident and response work, and a restoration plan is developed to identify the amount and type of restoration needed to return resources to their baseline condition.

Response vs. restoration

The Oil Pollution Act of 1990 addresses environmental impacts from a spill through two mechanisms:

Response - Actions taken to contain and remove oil from the water and shoreline and minimize damage to the public health and welfare.

Restoration - Actions taken to restore or replace injured natural resources and compensate the public for temporary lost use of those resources.

Research vessel *Irish* leaves Port Fourchon, La., for mesophotic reefs study, September 2014.

A researcher prepares to use a remotely operated vehicle to study reef fish in September 2014.

Federal and state natural resource trustees manage the NRDA process, deciding timing, duration, scope and public involvement. BP has paid for most of the work – about $1.3 billion to date, including nearly $700 million paid directly to the trustees.

NRDA is organized into three phases, some of which can overlap:

- **Pre-assessment** – In the days after the spill – before oil reached the shoreline – BP and the trustees collected information to help determine the baseline condition of natural resources before the accident. Next, they confirmed the presence or absence of oil across the affected area to assess the potential for injury to natural resources.

- **Injury assessment** – Experts are studying a wide range of wildlife and habitats to quantify injuries. Meanwhile, economists are evaluating how the spill affected recreational uses of the natural resources. Before the trustees prepare a final injury report, the public will have an opportunity to comment on a draft report and ask questions.

- **Restoration** – Once injury is determined, the trustees identify restoration projects that will return injured resources to their baseline condition, compensate for temporary losses that may occur before the restoration is complete and address lost recreational use of the resources. This includes direct restoration or rehabilitation of injured areas or alternate projects such as creating new wetlands or restoring nearby resources. Restoration usually occurs after the injury assessment is completed, but BP is providing funding earlier in the process through a unique early restoration program.

Analysis of data gathered through the NRDA continues. In addition to cooperative studies, where the trustees and BP agree on a work plan and cooperate on the investigation, both parties also conduct independent studies without the participation of the other party.

Who are the trustees?

- **The National Oceanic and Atmospheric Administration,** on behalf of the U.S. Department of Commerce
- **U.S. Department of Interior,** as represented by the U.S. Fish and Wildlife Service, National Park Service and Bureau of Land Management
- **U.S. Department of Agriculture**
- **U.S. Environmental Protection Agency**
- **U.S. Department of Defense**
- **The State of Alabama's** Department of Conservation and Natural Resources and Geological Survey of Alabama
- **The State of Florida's** Department of Environmental Protection and Fish and Wildlife Conservation Commission
- **The State of Louisiana's** Coastal Protection and Restoration Authority, Oil Spill Coordinator's Office, Department of Environmental Quality, Department of Wildlife and Fisheries and Department of Natural Resources
- **The State of Mississippi's** Department of Environmental Quality
- **The State of Texas'** Parks and Wildlife Department, General Land Office and Commission on Environmental Quality

Scientific studies of residual oil

Scientific reports developed to support the Deepwater Horizon response played a critical role in guiding cleanup operations. The reports provided a science-based understanding of what happened to the oil, and the potential effects on people and the environment.

Interagency Operational Science Advisory Teams (OSAT), made up of scientists from several federal agencies and BP, produced the reports. The OSAT teams' extensive sampling and analysis revealed that weathering processes such as dissolution, evaporation and biodegradation caused the oil to undergo tremendous physical and chemical changes.

Those changes reduced the volume and concentration, minimizing the potential to impact the environment the farther the oil traveled from the well and as more time passed.

"Based on the robust sampling effort, the expert analysis of the data provided in this report [OSAT-1] and the decision criteria summarized above, I have determined that there is no actionable oil in the water or sediments of the deep water or offshore zones."

U.S. Coast Guard Federal On-Scene Coordinator, December 17, 2010

An assessment team searches for potential submerged oil deposits near Pensacola, Fla. in April 2013. OSAT-3 data were used to identify areas for further investigation.

OSAT-1 Report (December 17, 2010)[22]

Scientists collected and analyzed about 17,000 water and sediment samples to study the status of oil and dispersants in the Gulf. Based on OSAT-1, the Coast Guard determined that there was no actionable oil in the deepwater or offshore zones for both water and sediments.

Key findings:

- None of the water samples analyzed exceeded the EPA benchmarks for protection of human health.
- After Aug. 3, 2010, no water samples exceeded EPA aquatic life benchmarks for dispersants or polycyclic aromatic hydrocarbons (PAHs) that were consistent with Macondo oil. PAHs were the oil compounds of greatest concern.
- Only about 1 percent of sediment samples taken after Aug. 3, 2010 exceeded EPA aquatic life benchmarks for PAHs, and only those within around two miles of the wellhead were consistent with Macondo oil.
- No deposits of liquid phase Macondo oil were identified in sediments beyond the shoreline.

OSAT-1: Ecotoxicity Addendum[23] (July 8, 2011)

Scientists evaluated toxicity data to understand potential impacts of residual oil and dispersants in both the nearshore and offshore marine environment.

Key findings:

- Of 3,500 toxicity tests conducted, 90 percent showed no statistically significant effects.
- None of the concentrations of dispersant-related constituents found in the sediment and water samples collected after Aug. 3, 2010 in the nearshore zone exceeded EPA's chronic aquatic benchmarks.

OSAT-2 Report (February 10, 2011)[24]

After most of the residual oil was removed from the shoreline, findings from this report helped guide cleanup of the remaining material. The report examined data collected from beaches in Alabama, Florida, Louisiana and Mississippi.

Key findings:

- Weathered oil samples collected for the study showed 86 to 98 percent depletion of total PAHs.
- Calculated potential human health effects from short- and long-term exposure to oil residue were below EPA acceptable risk levels.
- Based on a net environmental benefit analysis, any additional cleanup of oil residue may disturb sensitive habitats and wildlife, posing a greater environmental risk than leaving the residue in place.

OSAT-3 Report (Florida, Alabama, Mississippi – January 15, 2014,[25] Louisiana – May 2, 2014)[26]

An integrated scientific approach was used to identify potential discrete pockets of subsurface material. The OSAT-3 data were then used to locate and recover potential material.

Key findings:

- Since initial oiling, the majority of shoreline and nearshore areas have undergone sufficient erosion (vertically and laterally) to result in breakup and/or redistribution (and cleanup) of the initial sand/oil deposits. In addition to these natural processes, buried oil deposits were excavated by response teams once they were revealed by erosion or delineated during field activities.
- Further residual oil remobilization along some shoreline in the Area of Response may occur, but the conditions needed to remobilize (and the locations of these re-oiling occurrences) are generally predictable.

Wildlife and habitat studies

Studies on a range of wildlife species and habitat have confirmed that most environmental impact from the accident was limited in duration and geography, and the natural resources that were affected are rebounding. BP has seen no data to suggest a significant long-term population-level impact to any species.

While NRDA is the legal process that determines natural resource damages, a number of other studies are providing insight on the accident's potential impact on the environment. This work includes government reports and third-party studies by scientists who received funding through sources that include the Gulf of Mexico Research Initiative (GoMRI) and the National Science Foundation.

This section includes summaries of some preliminary NRDA and third-party findings.

Examples of wildlife and habitat studied

Birds

Beach

Marsh

Marine mammals

Sea turtles

Blue crab

Fish

Deepwater organisms and sediments

Zooplankton*

** Photo: Dag Altin, BioTrix*

Birds

The Gulf of Mexico is an important habitat for hundreds of millions of migratory and resident birds.[27] Analyses and field observations conducted to date indicate any impacts on bird populations and nesting were limited and were followed by a strong recovery.

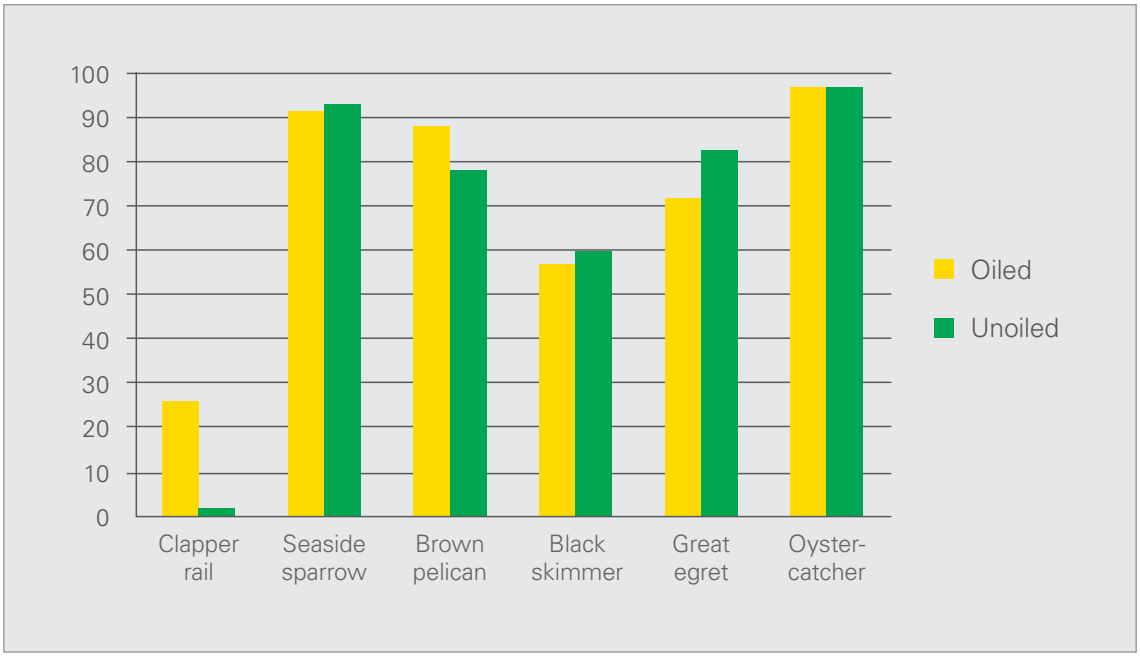
Wildlife biologists have used several types of studies to assess the health and density of bird populations in the Gulf, including studies on oiling, survival, productivity and density. The evidence from NRDA studies does not reveal ongoing adverse impacts to bird populations linked to the spill beyond the initial, limited acute mortality.

- **Oiling:** Based upon data collected cooperatively by government and BP experts, researchers saw no visible oil in 99 percent of the roughly 500,000 live bird observations from May 2010 to March 2011. Heavy oiling was reported in less than 0.1 percent of the observations.[28]
- **Survival:** Survival studies of six bird species found that oiled birds survived at a high rate. Hundreds of birds were fitted with transmitters that provided data on survival rates. After adjusting for factors such as weather, body weight and capture date, five species – great egret, brown pelican, clapper rail, seaside sparrow and American oystercatcher – showed no differences in survival rates between oiled birds and unoiled birds in the area of potential impact as well as birds in areas not affected by the spill. The results of tests from the sixth species, the black skimmer, were inconclusive due to transmitter and methodological issues.[29]

Preliminary bird findings

- Only a small percentage of birds observed after the accident were oiled.
- Birds with light or trace oiling survived at a high rate.
- Bird studies suggest that bird nesting and reproduction rates were normal in 2011, one year after the accident.

Tagging and tracking: comparing survival of birds in oiled vs. unoiled areas



The chart shows the percentage of birds that survived until the end of the study period before adjusting for factors such as weather, body weight and capture date.

Brown pelicans travel along a Gulf shoreline, September 2014.

- **Productivity:** Data from studies that BP conducted independently indicate that in 2011, the spill did not adversely impact bird productivity – how successful birds are at producing offspring. Brown pelicans, laughing gulls, great egrets, black skimmers, bald eagles and ospreys were studied. Comparisons of colonial waterbird colonies between different years suggest that the number of observed breeding colonies is stable and has not decreased from the levels recorded before the accident.[30]

- **Density:** Surveys were conducted in May 2010 – before most oil made landfall – and in May 2011 to compare pre- and post-impact abundance. The data showed that overall patterns in bird density did not change between 2010 and 2011.[31] The surveys included the most heavily oiled coastal habitats. The observations were consistent with data collected for the annual Audubon Christmas Bird Count.[32] BP continues to monitor bird density through an independent NRDA study.

- **Bird mortality model:** From May 2010 to August 2011, BP and the trustees conducted studies to determine the relationship between observed beached bird carcasses and total bird mortality.[33] This included studies on searcher efficiency and bird carcass persistence on beaches and in the water. The studies helped gauge the probability that bird carcasses would be found versus, for example, sinking in the water or being consumed by predators. Field biologists spent approximately 3,500 hours walking around 5,350 miles of beach to gather the data.

By understanding these site-specific variables, wildlife experts can estimate overall bird mortality. In contrast to this scientific approach, the authors of a 2014 paper used a series of deeply flawed assumptions to model bird mortality.[34] If the authors had used numbers specific to the Deepwater Horizon accident in their models, their estimates would be substantially lower. For instance:

- The authors assumed only 1 percent of the birds that died at sea washed ashore. However, cooperative NRDA field studies suggest that more than 70 percent of birds washed ashore.[35]

- The authors also assumed that wildlife search teams only found 42 percent of large birds and 7 percent of small birds. However, results from the cooperative studies suggest that on sandy shorelines, search teams likely found 97 percent of large birds and 78 percent of small birds.

Comparing population trends through the years

Species*	2006	2007	2008	2009	2010	2011	2012
Laughing gulls	12.4	11.3	9.0	10.2	10.6	9.3	10.8
Brown pelican	2.9	2.6	2.2	2.4	2.5	3.0	2.6
Northern gannet	1.2	0.7	0.9	1.0	0.5	0.7	1.0
Black skimmer	1.4	0.9	1.6	1.6	1.2	2.3	1.4
Piping plover	0.02	0.02	0.01	0.02	0.01	0.01	0.02
Royal tern	1.1	0.9	0.9	0.9	1.0	1.1	1.0
Common loon	0.3	0.3	0.3	0.3	0.2	0.3	0.3
Sandwich tern	0.2	0.3	0.2	0.2	0.1	0.3	0.3
Great blue heron	1.1	1.0	1.0	0.9	1.1	1.1	1.0
Forster's tern	0.9	0.7	0.8	0.9	0.7	1.1	1.0
Red knot**	13,445	12,375	15,395	24,000	14,475	12,804	25,488

*Numbers viewed per hour **Total number of birds viewed

Data taken from annual Audubon Christmas bird counts and U.S. Fish and Wildlife Service surveys (for red knots) show that population numbers for 11 bird species that inhabit or migrate through the Gulf have returned to the levels seen before the accident.

In addition to the NRDA studies, a number of third-party studies contribute to what is known about the health of the Gulf's bird populations. For example:

- **Northern gannets:** A 2014 paper examined potential effects of oil from the accident on the reproductive success of northern gannets that migrated from Canada and overwintered in the Gulf during 2010-2011. Finding no PAH concentrations in the blood of birds, researchers concluded, "if Bonaventure Island-breeding Northern gannets had been exposed to oil in the Gulf of Mexico… this exposure could not be associated with changes in hormonal status and body mass in breeding individuals."[36] The researchers also did not find a difference in body mass between the birds that overwintered in the Gulf and those that overwintered on the Atlantic Coast.

- **Brown pelicans:** In a study published in 2014, researchers at the University of Louisiana at Lafayette and the Louisiana Department of Wildlife and Fisheries did not find evidence that variations in the proportions of brown pelicans in different age classes on Louisiana barrier islands were related to the accident.[37]

Shorebirds forage for food along the Louisiana coast.

Shopping for fish in a Pensacola, Fla. seafood market, July 2012.

Seafood and other aquatic organisms

Finfish and shellfish populations in the northern Gulf of Mexico are robust and the seafood is safe to eat based on data government agencies and university researchers collected.[38]

Scientists have extensively investigated the health and abundance of seafood and other aquatic organisms, including more than 50 NRDA studies on aquatic species ranging from single-celled phytoplankton to large game fish.

A review of several decades of published scientific research and government data show that fish and shellfish populations in the Gulf of Mexico did not experience significant, long-term harm. The data indicate that by 2011, common and important commercial and recreational fishery species were within pre-existing harvest trends and ranges. Based on the latest available data, this pattern has continued.[39]

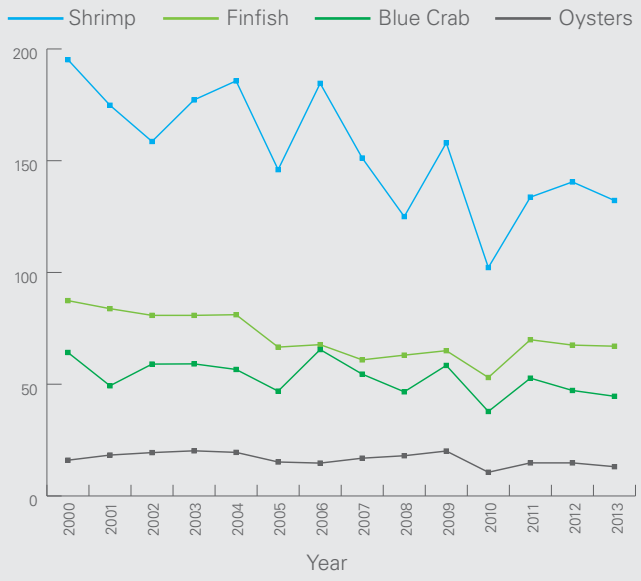
Similar conclusions were reached in a September 2014 scientific paper that examined a wealth of published research spanning different species, ecosystems and timeframes. Based on their review of this scientific literature, the authors found that although some individual fish may have been impacted, there was an "absence of measurable negative impacts among populations."[40]

In addition, data from NOAA show that post-spill Gulf commercial landings generally have been consistent with pre-spill population ranges and trends.[41]

When coupled with other data, landing trends can signal the health and vitality of fisheries. A 2014 scientific paper concluded that "commercial landings data suggest that a majority of its [Gulf of Mexico] fisheries were on the way to recovery just one year after the spill, if not earlier."[42]

Volume of commercial landings
(Ala., La., Miss., Fla. Gulf)

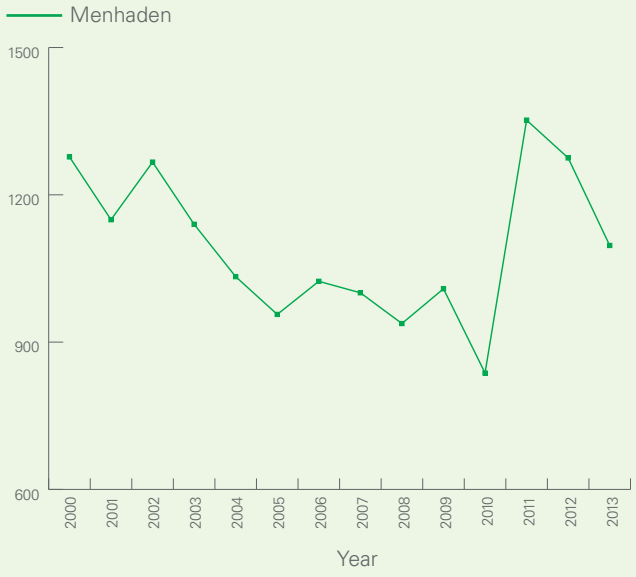
Weight in millions of lbs



Source: NOAA

Volume of Gulf menhaden landings
(Ala., La., Miss., Fla. Gulf)

Weight in millions of lbs



Source: NOAA

Commercial landings in the Gulf have generally been consistent with pre-spill ranges and trends.

Finfish

Commercial landings for finfish, including menhaden, which are harvested and processed into fish feed and oils, continue to exceed immediate pre-spill levels. As with other aquatic life, many factors can cause finfish populations to fluctuate. While findings from many NRDA studies are awaiting publication, numerous third-party studies and government reports have been published, including:

- **Red snapper:** In an Auburn University study published in 2014, researchers found no evidence that the spill affected young red snapper populations on reefs off the Alabama coast. After counting the number of young red snappers before and after the accident, the researchers concluded, "any oil spill effects on early life stages of benthic Red Snapper were negligible." The researchers said these findings were particularly significant since this area has the highest abundance of juvenile red snappers in the Gulf, and the extent and duration of the oil plume were greater off Alabama's coast than at many other juvenile red snapper habitats.[43]

- **Reef fish:** Red snapper and other fish that live in reefs are called "reef fish." Researchers from the University of South Alabama and Dauphin Island Sea Lab in Alabama took samples of reef fish from the Alabama and western Florida Panhandle coasts from January 2010 to June 2011. They found no significant evidence of diseased fish in those populations.[44]

  NRDA research cruises have looked at fish abundance and the health of coral communities in mesophotic reefs, including 2014 cruises that used remotely operated vehicles to explore reefs off the coast of Alabama. Unlike deepwater coral ecosystems, mesophotic reefs are generally found 100 to 500 feet beneath the sea in areas that are still penetrable by light.

- **Seagrass fish:** Seagrass is a critical habitat for fish, crab and shrimp species. Researchers from the University of North Carolina and Dauphin Island Sea Lab published a study in 2011 that found no effect on the community composition and abundance of juvenile fish in seagrass habitat in the months after the spill. The researchers concluded, "immediate, catastrophic losses of 2010 cohorts were largely avoided, and that no shifts in species composition occurred following the spill." Notably, the 2010 post-spill catch rates were higher than in the previous four years.[45]

- **Killifish and other marsh fish:** Since killifish are prey for other species, changes in abundance could affect marsh ecosystems. In a study published in

NRDA scientists studied reef fish abundance off the coast of Alabama, September 2014.

2013, researchers in a laboratory setting exposed killifish embryos to sediments taken from several oiled locations and found that this increased developmental abnormalities.[46] However, in a response published in the same journal in 2014, another expert stated,"I do not find the materials to offer a convincing prediction of population-level effects for several reasons." These included an "inadequate" number of sampling locations, the failure to determine an effect threshold and the fact that "effects at the egg stage do not necessarily translate to effects at the population level and frequently do not." The expert pointed out that preliminary research on juvenile fish residing in Gulf seagrass beds had not revealed any dramatic declines in abundance or species composition.[47]

In an October 2014 scientific paper that evaluated killifish and other fish that live in marsh areas, researchers concluded there were "no obvious oil effects on numerous metrics (composition, abundance, size, and assemblage composition)." The researchers sampled both oiled and unoiled marsh areas in Louisiana in 2012 and 2013. They reported that "Despite this exposure to oil, there were no overt signs of decreased abundance in these marshes."[48]

A study published in 2015 by researchers from Auburn University, the University of Windsor and Dauphin Island Sea Lab found no significant differences in chemical markers in the bodies of killifish collected at oiled sites vs. unoiled sites. The researchers said, "our results support a minimal effect of the DHOS [Deepwater Horizon] spill on *F. grandis* [killifish], a trend that has also been observed for other nearshore fauna in the northern Gulf of Mexico." The researchers sampled killifish from 10 sites across Louisiana, Mississippi, Alabama and Florida.[49]

In a study published in 2013, the Dauphin Island Sea Lab and the University of South Alabama studied finfish and shellfish in an Alabama marsh from 2009, the year before the spill, to 2012. The researchers determined there is little evidence of severe acute or persistent oil-induced impacts on organisms that live in Alabama marshes.[50]

- **Tuna:** Data indicate that the Deepwater Horizon accident had the potential to affect only a fraction of the overall spawning area of bluefin tuna.

A study by university and government researchers examined the overlap between spawning habitat and oiled waters and concluded that the spawning area for bluefin tuna extended much farther west than previously known and that "the proportion of spawning habitat impacted by oil was generally predicted to be small (<10%)."[51] Bluefin tuna also live relatively long lives and have multiple age classes that contribute to the overall population in any given

year; thus, any effects on a single year class (e.g., individuals born in 2010) would have a relatively small effect on the overall population.

According to the 2014 tuna stock assessment from the International Commission for the Conservation of Atlantic Tuna, compared to the past few decades, larval levels in the Gulf of Mexico were relatively high in 2011 and 2013, the last two survey years.[52] This indicates an abundant breeding population.

Two lab studies – one that bathed isolated heart cells with oil-water solutions and another that mixed oil and water at extremely high speeds in a food blender – speculated that crude oil exposure could affect the hearts of bluefin tuna embryos and fish.[53] However, tuna have numerous defensive mechanisms not found in isolated heart cells. Also, a food blender is a non-standard experimental laboratory method that artificially increases toxicity and does not represent actual oil exposure in the Gulf of Mexico.[54] The researchers even acknowledged numerous uncertainties related to this kind of laboratory work. The studies provided no evidence to suggest a population-level impact on tuna or other fish species in the Gulf.

- **Greater amberjack:** A NOAA stock assessment of greater amberjack in the Gulf of Mexico released in March 2014 found possible evidence for strong recruitment classes after the spill.[55]

Shrimp

Most domestic shrimp are harvested from the Gulf of Mexico. To assess health and abundance, Gulf shrimp have been studied through both surveys and laboratory tests. Results show that shrimp are plentiful and safe to eat.

The National Marine Fisheries Service (NMFS) conducts periodic stock assessments of brown, pink and white shrimp in the Gulf, comparing shrimp population characteristics such as spawning stock, size and mortalities to previous years. The reports for 2011, one year after the spill, indicate that the number of shrimp in the Gulf of Mexico were similar to previous years.

- The report on brown shrimp said, "This assessment reveal an increasing trend in spawning biomass and recruitment in recent years, and a decreasing trend in fishing mortality during the later portion of the time series [1984-2011]."[56]

- According to the report on pink shrimp, "The stock has been showing an increasing trend in spawning biomass and recruitment in recent years, and a decreasing trend in fishing mortality."[57]

Seafood testing

Gulf seafood is among the most rigorously tested sources of seafood on the market. Since May 2010, the Food and Drug Administration (FDA), NOAA and the Gulf states have tested more than 10,000 finfish and shellfish specimens and levels of PAHs in seafood consistently have tested 100 to 1,000 times lower than FDA safety thresholds.[58]

The FDA and NOAA also created a new test that can detect dispersants in fish tissue. Every sample tested was well below FDA levels of concern, with 99 percent of the samples showing no detectable residue.[59]

BP has provided $25.3 million to Alabama, Florida, Louisiana and Mississippi to support the state-led testing programs.

- White shrimp exhibited similar trends: "increasing spawning biomass and recruitment in recent years, and a decreasing trend in fishing mortality during the later portion of the time series [1984 – 2010]."[60]

In addition, based on a review of three decades of data from the Southeast Area Monitoring and Assessment Program (SEAMAP), the abundance of white and brown shrimp appears to be within long-term historic trends and averages.[61] SEAMAP is a government and university program established to collect and disseminate fishery-independent data.

Blue crab

Through NRDA studies, blue crabs were assessed in the field and tested in laboratories to determine the potential effects of oil exposure. Data analysis is ongoing.

A stock assessment report issued by the Gulf States Marine Fisheries Commission in June 2013 found that blue crab abundance in 2010 and 2011 were within natural variability. The report showed that through 2011, blue crab stocks in the Gulf were consistent with the same trends (declining to stable) seen over the past several decades.[62]

Plankton

Plankton are fish larvae and eggs, photosynthetic plants and organisms, and other small marine animals that drift in the water column. These tiny organisms are a vital food source for fish and marine mammals. More than 20 NRDA research cruises were conducted to examine the diversity, abundance and distribution of plankton communities.

Preliminary data analyses indicate that any potential impact on plankton likely occurred in a limited geographic area and was short-lived. This is because most plankton have short life spans and most phytoplankton reproduce in hours or days.[63]

Oysters

A wide variety of oyster studies have been conducted and data from multiple sources indicate that oil and dispersant compounds from the Deepwater Horizon accident did not affect oyster populations.

- In its 2010 oyster stock assessment report, the Louisiana Department of Wildlife and Fisheries (LDWF) stated, "no direct oiling of sampled reefs was noted" during annual sampling of public oyster seed grounds in Louisiana.[64]

- Field notes from 2010, 2011 and 2012 NRDA sampling do not document any visibly oiled oyster beds. In 2013, there was a single report of oil on a cluster of oysters in Louisiana in the vicinity of a small spill unrelated to the Deepwater Horizon accident. The trustees have not released the results of testing conducted to determine the oil's source.[65]

- Research by the University of New Orleans concluded that oyster condition, reproductive state and disease occurrence were normal following the accident and were comparable across oil-exposed and unoiled sites. The researchers reported that "No oil was observed on the water surface, in the water column, or on or in oysters" during sampling of oil-exposed sites in Lake Borgne and Mississippi Sound in January 2011.[66]

- Oyster studies conducted as part of the NRDA, as well as by NOAA's Mussel Watch program and academia, produced thousands of oyster chemistry samples. NOAA reviewed the Mussel Watch chemistry results and concluded, "Overall, the levels of PAHs in both sediment and oysters both pre- and post-landfall were within the range of historically observed values for the Gulf of Mexico."[67]

- There have been reports of relatively low oyster larval settlement across the northern Gulf of Mexico starting in 2010. However, these reports indicate relatively low settlement occurred whether in oil-exposed areas or dozens of miles from any oiling. Perhaps more importantly, LDWF data indicate that Louisiana's oyster stock estimates decreased by over 85 percent between 2001 and 2009.[68] Lower spat settlement may be primarily reflective of the plummet in the reproductive stock size over the previous decade.

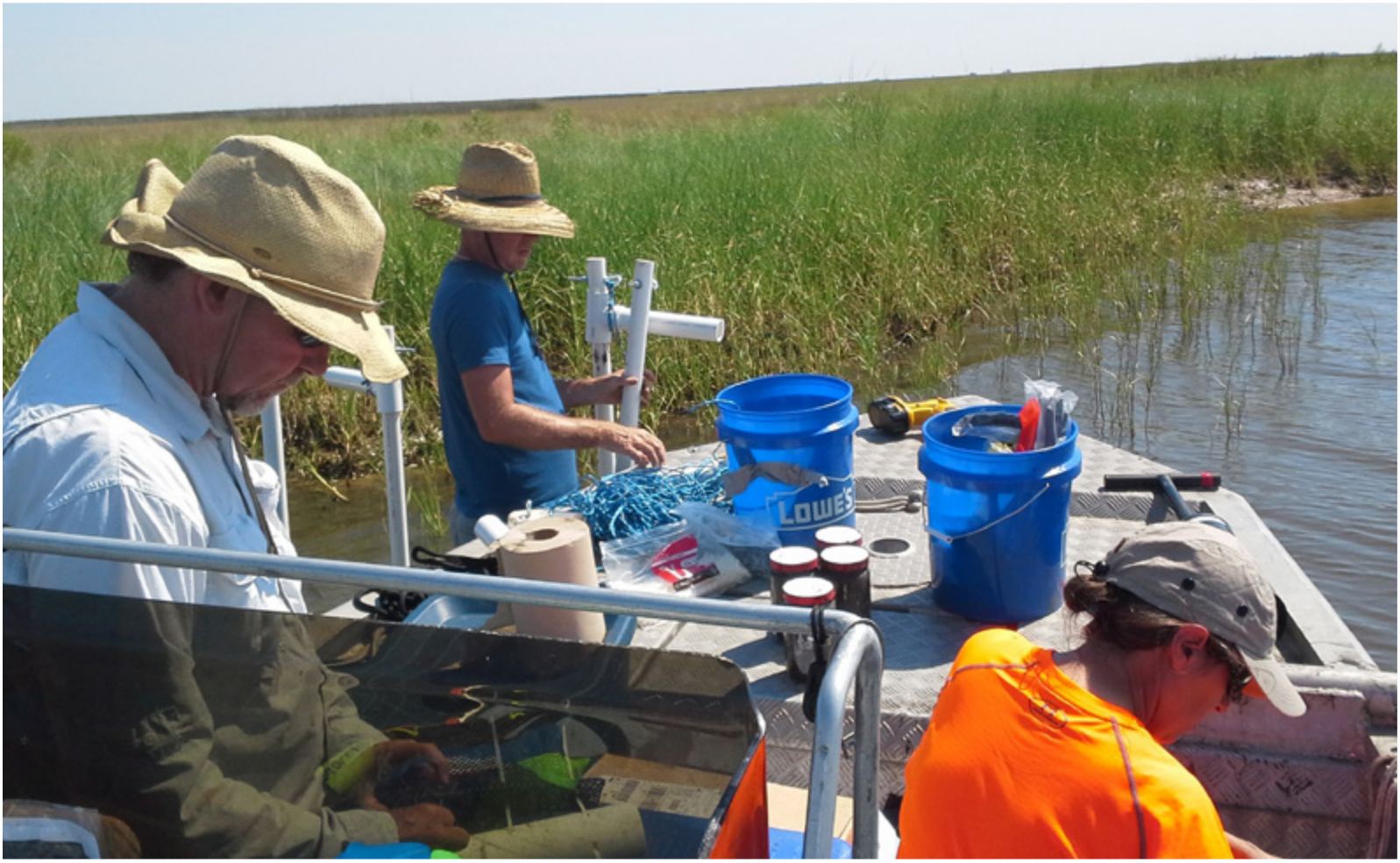
Government officials and resource experts have documented other conditions that have affected the Gulf's oyster population, including freshwater releases, flooding and drought conditions. Oysters are sensitive to changes in salinity, and these types of events can cause water salinity to change to levels that affect oysters' survival. For example:

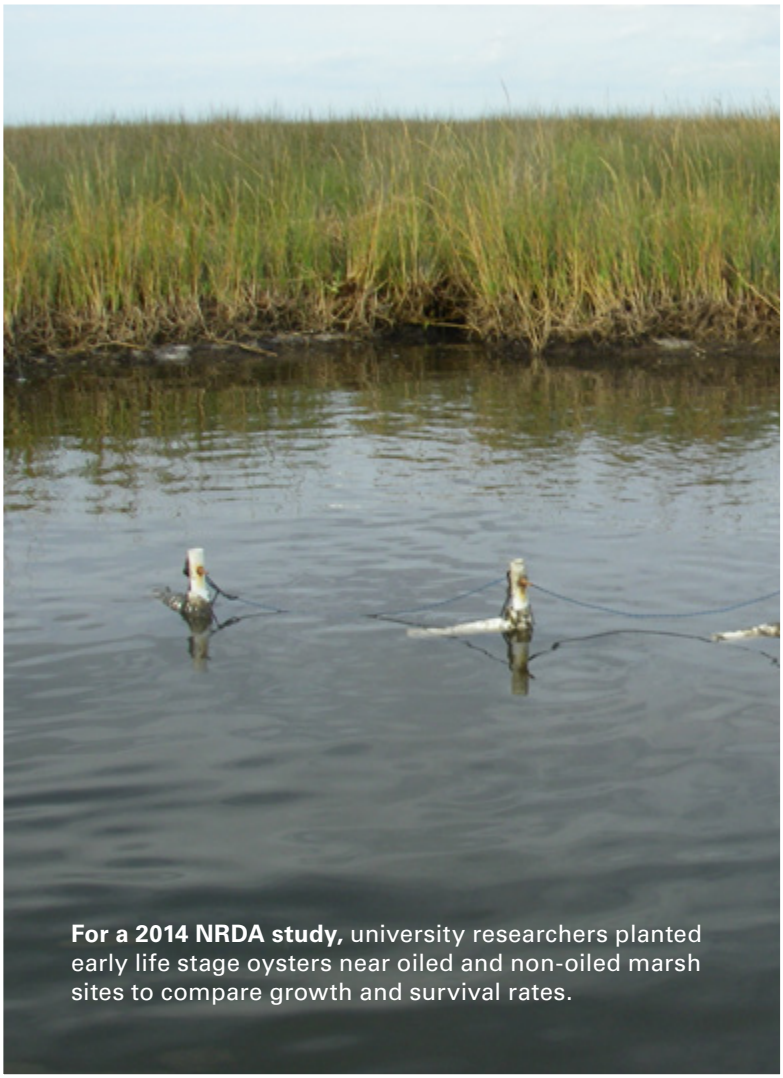
- Damage to Louisiana oyster populations during the spring and summer of 2010 was likely due to Louisiana's decision to open freshwater diversions, which sent freshwater into oyster beds, lowering the salinity to harmful levels. A LDWF oyster mortality study in 2010[69] and research by Louisiana State University found that low salinity caused the high oyster mortality observed in 2010.[70]

- Historic 2011 Mississippi River flooding inundated coastal Louisiana and pushed substantial amounts of freshwater into Louisiana waters, lowering salinity to levels harmful to oysters.

- The U.S. Department of Commerce cited flooding as the cause of a commercial oyster and blue crab fisheries failure in Mississippi in September 2012.[71]

- Citing "excessive drought conditions in Apalachicola Bay and elsewhere in the Florida Panhandle during the 2012-2013 winter fishing season," the Department of Commerce declared a fishery resources disaster for West Florida's oyster fishery in 2013.[72] West Florida's landings declined 61 percent between 2012 and 2013 based on NOAA data.





For a 2014 NRDA study, university researchers planted early life stage oysters near oiled and non-oiled marsh sites to compare growth and survival rates.

A bottlenose dolphin near the Mississippi coast, October 2011.

Marine mammals

The trustees and BP have investigated potential impacts to marine mammals in the Gulf. An examination of the available data does not reveal evidence that the spill harmed Gulf marine mammal populations.

Starting in 2010, BP paid for studies that integrated several techniques to examine large oceanic marine mammals, including oceanic and coastal/continental dolphins, sperm whales, beaked whales and Bryde's whales. The studies used aerial surveys to estimate populations, satellite telemetry to track individual animals and acoustic technology to determine how many animals inhabit which areas. Anchored recording devices were used to identify species and population sizes through their sounds.

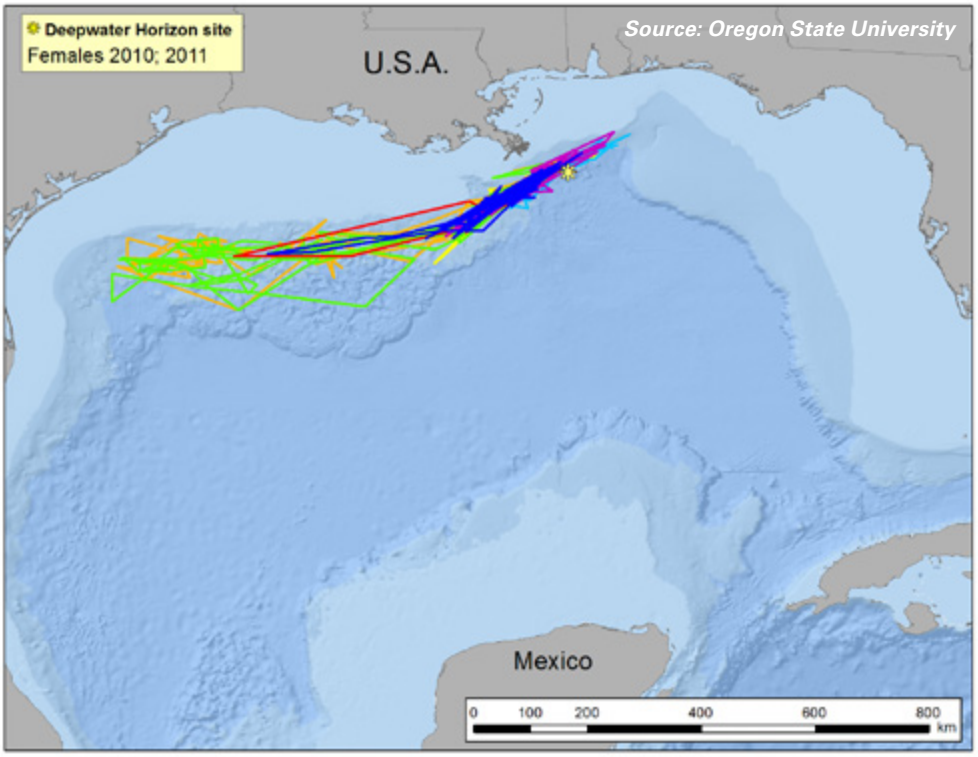
Dolphins

Federal agencies have collected a considerable amount of data to investigate the potential impact on bottlenose dolphins in the Gulf. The agencies began providing critical necropsy (animal autopsies) data to BP in 2014. An examination of this and other information reveal there is no evidence to conclude that the Deepwater Horizon accident had an adverse impact on bottlenose dolphin populations in the Gulf of Mexico:

- An "unusual mortality event" (UME) involving an abnormally high number of dolphin deaths in the Gulf of Mexico began in February 2010, months before the Deepwater Horizon accident.[73] UMEs occur with some regularity in the Gulf of Mexico and around the world, and according to NOAA have in the past been caused by infections, biotoxins, human interactions or malnutrition.

- NOAA continues to investigate the Gulf UME and has not identified the cause. However, NOAA has said that *brucella,* a bacterium that can infect animals, is "a common thread" in a number of the animals examined. Nearly one-third of the dolphins tested as of Nov. 25, 2014 were positive for *brucella*.[74]

Technology provides information on locations, numbers and movements of marine mammals



Satellite telemetry tracks sperm whales in the northern Gulf.

- A review of the necropsy reports of 130 dolphins collected along the northern Gulf of Mexico shoreline from April 20, 2010 to May 30, 2011 shows that none of these 130 dolphins examined by veterinarians had oil listed as the cause of death. However, numerous other causes of death – unrelated to oil – were indicated. A number of reports do not list a cause of death.[75]

- The government's "Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report" shows that of the dolphins collected at the time of the last report, only two live dolphins and 10 dead dolphins were visibly oiled.[76] The report also states that oiling status is "not an official determination of cause of death."

- A cooperative NRDA health assessment that compared dolphins in Barataria Bay to a reference population in Sarasota, Fla.,[77] failed to establish a link between the observed health of the Barataria Bay dolphins in 2011 and 2013 and potential exposure to oil.[78] It also failed to take into account that Barataria Bay contains numerous stressors that could explain the poor health of some dolphins.

- The increase in reported mortality observations after the spill may reflect an increase in the number of observers in the Gulf and an increased awareness among Gulf residents. The NRDA trustees have acknowledged that "Due to the increased number of trained people evaluating the spill impacted areas, it is also likely that we will recover more naturally injured or dead fish and wildlife than normal."[79]

Whales

Data from NRDA studies on whale populations, movements and reproduction success are being finalized. While data analysis is ongoing, BP has not seen any evidence indicating that oil or dispersant compounds from the Deepwater Horizon accident have impacted the health of whales in the Gulf.

Examples of whale-related studies:

- Cornell University tracked the movements of whales and dolphins, using bioacoustics monitoring.

- Scripps Research Institute deployed five acoustic recording devices in the Gulf to evaluate presence, distribution and abundance of marine mammals such as sperm and beaked whales.

- Oregon State University tagged and satellite-tracked sperm whales.

Sea turtles

Through the NRDA, scientists are studying two Gulf species – Kemp's ridley and loggerhead – to evaluate the potential for exposure to oil and dispersant compounds, and assess potential effects.

For decades, state and federal agencies have gauged sea turtle population levels by tracking two important metrics: number of nests and "strandings."

In Florida, the number of loggerhead nest counts recorded on Panhandle beaches in 2011 were close to the average for the preceding five-year period, and the 2012 counts were the highest recorded in 16 years.[80] The number of nests dipped in 2013 and 2014 but remained higher than pre-spill years.

For Kemp's ridley sea turtles, nesting numbers the two years after the accident were above historical averages.[81] In 2013 and 2014, nest counts were not as high as the two preceding years. The changing nesting trends could be due to many factors including natural variability and record cold temperatures, which can cause a phenomenon known as "cold stun" that leaves sea turtles immobile and unable to swim.

Strandings refer to dead, sick or injured sea turtles that wash up on shorelines. Data show that most stranded sea turtles collected following the accident were not killed by oil.

- The "Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report" shows that only 18 of the 613 sea turtles listed as "Collected Dead" were visibly oiled.[82] The report also states that oiling status is "not an official determination of cause of death."
- In late 2010, NOAA said that necropsies conducted on hundreds of sea turtles showed that the majority of stranded sea turtles likely got caught in fishing gear and drowned. NOAA also said "to our surprise, most of the dead stranded sea turtles had no observable oil on their bodies and were in good health prior to their death."[83]
- Nearly all of the 456 sea turtles that were collected alive and visibly oiled survived and were released back into the environment following their rehabilitation.[84]
- In a scientific paper published in 2013, NOAA said that the increase in sea turtle strandings reported in 2011 was likely influenced by increased monitoring and reporting.[85]

Other NRDA studies on sea turtles continue. A total of 116 sea turtles were outfitted with satellite tags and tracked. Data were gathered along 4,700 miles of shoreline. More than 7,000 egg tissue and body samples were collected and nesting conditions and movements were documented.

More than 450 sea turtles were cared for and released from marine mammal and sea turtle rehabilitation centers set up after the accident.

Orange Beach, Ala., 2011.

Shoreline

Scientists have found that oiled beaches and marsh areas largely have recovered, and the amount of shoreline that was heavily oiled decreased rapidly and dramatically due to cleanup operations and natural processes.

The Gulf's beaches, lagoons and bays stretch along more than 16,000 miles. Aerial reconnaissance flights were conducted across virtually this entire area in 2010. Shoreline Cleanup Assessment Technique (SCAT) teams comprised of government and BP scientists then identified 4,379 miles for further ground-based survey.

Through the ground surveys, scientists determined that most of the Gulf shoreline was never oiled. Of the 1,096 shoreline miles with some oiling, the majority was light, very light or trace. Oiling was not continuous. A shoreline mile was categorized as oiled even if only a portion of the area within the mile expanse was actually oiled.

At maximum observed oiling conditions, just over 220 miles of shoreline were characterized as heavily oiled. By mid-2011, that number was down to 13 miles,[86] and by early 2014, less than four miles were categorized as heavily oiled. Based on scientific assessments and experience, the Coast Guard and land owners determined that further cleanup in these areas would do more harm than good to the environment, and the areas were allowed to recover naturally.

Since some of the heavily oiled areas were last surveyed a year or two earlier, NRDA teams resurveyed the areas in 2014 and determined that a total of just one mile remained heavily oiled.

Federally-directed studies have confirmed that any oil that does remain is highly weathered and poses little health risk. The OSAT-2 report concluded in 2011 that 87 to 98 percent of total PAHs were depleted from the residual oil and concentrations of constituents of concern were well below levels of concern for human health.

The OSAT-2 report also found that aquatic and wildlife resources would likely experience a greater threat from further cleanup beyond established guidelines than from the oil that still remained on the beaches.

This site in Barataria Bay, La. was heavily oiled (left). Marsh grass was raked, and oiled material was collected. Significant vegetation regrowth is apparent in 2011 (right).

Marshes

Extensive investigations of marshes show they are experiencing significant recovery. Shoreline assessment teams surveyed 3,220 miles of marsh shoreline. At the time of maximum oiling, 86 miles were heavily oiled, with another 416 miles having moderate, light, very light or trace oiling. By early 2014, only 0.7 miles remained heavily oiled.[87]

Instead of penetrating deeply into the soil, the weathered oil typically pooled on the surface in affected areas and it stranded along the edge of most marshes.[88] That sped the recovery. According to scientists from NOAA and elsewhere, bulk oiling usually spread into the marsh no more than about 30 to 50 feet due to the small tidal range, the density of the vegetation and the oil's high viscosity.[89] The highest concentrations of oil were found within about 3 to 10 feet of the shoreline.[90]

Findings from other scientific papers and reports:

- A 2012 University of Florida study that measured the rate of marsh erosion in a limited geographic area in Louisiana showed that erosion rates returned to normal 18 months after the spill and that its impact was generally limited to the edge of the marshes.[91] The researchers also said marsh vegetation "displays remarkable resilience to oil spills" and recovered fully after approximately 18 months in non-eroded areas.
- Through a cooperative NRDA work plan, government agencies and BP studied more than 200 marsh sites in Louisiana, Mississippi and Alabama. A review of data from these sites as well as other information show that the vegetation at most of the heavily oiled sites appears to be recovering over time. For areas with a lesser degree of oiling, the vegetation was generally undistinguishable from non-oiled areas within a year.[92]
- Studies by Louisiana State University have examined *Spartina alterniflora* and *Phragmites australis,* two common types of Louisiana marsh vegetation. One study found that moderately oiled *Spartina alterniflora* (cordgrass) will begin to recover after seven months.[93] In the other study, researchers concluded that above-ground oiling of *Phragmites australis* (common reed) had "no major impact on overall plant growth." According to the researchers, below-ground oil exposure could limit growth depending on the amount of oiling.[94]
- Microorganisms played a role in the recovery of marshes, according to a study published in 2013. The researchers found that microbial communities in Louisiana marshes helped the oil degrade rapidly. Eighteen months after the accident, residual oil concentrations at impacted sites were similar to non-impacted areas.[95]

Deepwater and corals

Preliminary observations of the sea floor have identified abundant and diverse marine life in, on and above the sea floor, with no evidence of widespread impact to coral.

BP and the trustees continue to study the Gulf's deepwater environment to better understand how the current quantity and composition of deep sea marine species compare to those before the accident.

More than 20 deep sea cruises gathered samples and images from the Gulf's deepwater environment. During summer 2014, researchers revisited deepwater sites and collected sediments for chemical analysis and to study the organisms that live in the sediments.

Sediments

Since 2010, government and BP scientists have collected and analyzed thousands of sediment samples to identify Macondo oil markers, assess toxicity levels and investigate sedimentation rates. Data from the OSAT-1 report indicate that potential injury to the deep sea soft sediment ecosystem was likely limited to a small area in the immediate vicinity of the Macondo wellhead. This zone is the result of oil becoming entrained in drilling mud used during the efforts to seal the well.[96]

In contrast to the rigorous chemical analysis conducted on the thousands of sediment samples collected by government and BP scientists, other researchers have used tracer compounds to examine deepwater sediments. However, these tracers are common to all sources of oil, including oil from the Gulf's numerous natural seeps. In a study published in December 2014, researchers used a radiocarbon tracer to estimate that "between 0.5 to 9.1% of the released petrocarbon" was deposited in the deepwater sediments surrounding the spill site.[97] The material was no longer in the form of oil, thus the researchers' attempted to use carbon-14 to detect the presence of remnant oil.

However, their method for calculating carbon derived from oil was flawed and their estimates of the amount deposited on the sea floor was not supported by the data in their paper. A careful look at this data set shows that only three of their 62 sediment samples had evidence of excess petrocarbon when compared to pre-spill sediment samples. The researchers also did not chemically analyze the material to determine the source, and conducted no toxicity testing to understand if the material had the potential to affect organisms.

As part of an independent NRDA study, a remotely operated vehicle photographed and videographed sea life near the Macondo well area in March 2011.

Coral

Data published by a group of researchers, including scientists working with the NRDA trustees, show the accident did not affect the vast majority of deepwater coral communities. The researchers' July 2014 paper stated that "most known deep-water coral communities in the Gulf of Mexico do not appear to have been acutely impacted by the spill."[98]

The scientists observed numerous coral colonies, but identified only three coral communities that were potentially affected by oil, and one of these was near an active natural seep. The scientists said other sites that harbored thousands of coral colonies "continued to show no visible signs of recent impact."

Further, observations of marine life around the Macondo wellhead by Louisiana State University researchers found that most of the diverse types of marine animals that lived around the well before the spill were present at sites around the well after the spill.[99]

Human use

Through the NRDA process, economists are evaluating potential lost opportunities for recreational activities, including fishing, boating, swimming, hiking and wildlife viewing.

In addition to injuries to species and habitats, natural resource damages also include loss of human or recreational use of those resources. To collect data on how people use the Gulf, economists look at recreational data in high-use areas such as boat ramps, marinas, recreational beaches and sport-fishing areas, as well as state and national parks and wildlife refuges.

For example, through one cooperative NRDA effort, aerial shoreline images were collected to count the number of people using shoreline resources and estimate usage during and after the accident.

Analysis of historical information, such as state and national park visitation numbers, in addition to the NRDA data collection efforts, is ongoing and may provide further insight into potential impacts on recreational use.

Record-breaking tourism

Tourism in many Gulf areas has soared since 2010, indicating that recreational use has returned to or exceeded pre-spill levels.

Alabama: Gulf Shores and Orange Beach set records for taxable lodging revenue in each of the last four years.[100] Revenue per available room (RevPAR) in Gulf Coast counties in 2014 was 26 percent higher than 2009.[101]

Florida: Visitors to Florida set records in each of the last four years[102] and RevPAR for Panhandle counties in 2014 was 41 percent higher than 2009.[103]

Louisiana: Tourist spending in New Orleans during 2013 was the highest in history at $6.5 billion, a 4.5 percent increase over 2012, the previous record year.[104]

Mississippi: Hotel sales (taxable traveler accommodations) in 2014 along coastal counties were 24 percent higher than in 2009.[105]

Aerial imagery such as this 2011 photo of beach activity at Miramar Beach, Fla., was part of a NRDA human use study to estimate use of natural resources before and after the accident.

Restoring the environment

Dozens of early restoration projects – costing about $700 million – are underway across the Gulf Coast, from marsh creation and beach restoration to fisheries enhancements and state park improvements. This unprecedented program means environmental restoration has begun years earlier than the typical schedule.

Through a landmark agreement signed with the trustees in 2011, BP is voluntarily providing up to $1 billion for early restoration projects to speed recovery of natural resources injured as a result of the Deepwater Horizon accident. Restoration projects usually are funded only after the NRDA is complete and a final settlement has been reached or a final court judgment has been entered. This process often takes many years and restoration often is delayed during that time.

The agreement between BP and the trustees makes it possible for restoration to begin at a much earlier stage than is typical.

The trustees are responsible for identifying proposed projects and determining when and how to present them to the public for review and comment. BP and the trustees must agree on the potential projects, funding and the natural resources benefits the projects are expected to provide. The trustees then implement the projects.

The projects underway are located across Texas, Louisiana, Mississippi, Alabama and Florida. Examples include:

- **Louisiana Outer Coast Restoration – $318 million:** Beach, dune and back-barrier marsh habitats are being restored at four barrier islands. The project also will expand nesting habitat for pelicans, terns, skimmers and other waterbirds.
- **The Hancock County (Mississippi) Marsh Living Shoreline – $50 million:** Living shoreline techniques, including natural and artificial breakwater material and marsh creation, are being used to reduce shoreline erosion while encouraging reestablishment of habitat that was once present in the area.
- **Alabama Marsh Island Restoration – $11.3 million:** A breakwater is being created in front of the island to reduce erosion of the existing 24 acres of salt marsh habitat and create 50 acres of additional salt marsh habitat in Portersville Bay.

Early environmental restoration

$1 billion amount of funding BP committed for early restoration projects

54 projects in various stages of implementation across the Gulf

$698 million estimated costs of projects underway

Some early restoration projects are supporting bird habitats.

Early restoration projects

Texas
- 5 projects
- $19 million
- Artificial reefs, Sea Rim State Park enhancement, Galveston Island State Park beach development

Louisiana
- 4 projects
- $370 million
- Marsh and barrier islands restoration, oyster cultch, fish hatchery

Mississippi
- 7 projects*
- $83 million
- Artificial reefs, oyster cultch, living shoreline, bird nesting habitat, various recreational use projects

Alabama
- 7 projects*
- $108 million
- Marsh and dune restoration, bird and sea turtle habitat, living shoreline, oyster cultch, Gulf State Park enhancements

Florida
- 34 projects*
- $118 million
- Dune and seagrass restoration, beach nourishment, artificial reefs, oyster cultch, living shorelines, bird and sea turtle habitat, various recreational use projects

** Two projects span multiple states*

- **Florida Gulf Islands National Seashore Beach Enhancement – $10.8 million:** Fragments of asphalt and road-base material are being removed. The material was scattered widely over the Fort Pickens, Santa Rosa and Perdido Key areas of Gulf Islands National Seashore when storms and hurricanes damaged area roads. Vegetation will be replanted as needed.
- **Restoring the Night Sky – $4.3 million:** Streetlights and parking lot lights are being retrofitted to reduce the impact of artificial lighting on the nesting habitat of loggerhead sea turtles on Florida Panhandle and Alabama beaches.
- **The Matagorda Artificial Reef Project – $3.5 million:** A new artificial reef site is being created within Texas state waters, approximately 10 miles offshore of Matagorda County. About 160 acres of artificial reef will be constructed.

The estimated $698 million in early restoration projects was approved in three phases, with a public review and comment period for each phase:

Phase 1	Phase 2	Phase 3
8 Projects	**2** Projects	**44** Projects
$62 M Estimated cost	**$9 M** Estimated cost	**$627 M** Estimated cost
April 2012 Date approved	**Dec. 2012** Date approved	**Oct. 2014** Date approved

More details on the early restoration projects can be found at: http://www.gulfspillrestoration.noaa.gov/restoration/early-restoration/.

Types of restoration projects underway

Ecological – Addresses injury to natural resources such as fish, wildlife, biota and habitat (e.g., marshes).

Human use – Addresses the temporary loss of human use and enjoyment of natural resources such as when the beaches and waters were closed. The projects provide residents and visitors with new recreational options, better access to natural resources and a greater opportunity to enjoy them.

Restoring and protecting marshes is a part of several early restoration projects in Louisiana, Alabama, Mississippi and Florida.

Emergency restoration

Restoration has also occurred through emergency restoration projects. Emergency restoration actions are designed to avoid irreversible loss of natural resources, or to prevent or reduce any continuing danger to them. The trustees proposed three projects, which BP funded. Projects in Mississippi and Texas were completed in 2011; a Florida project was completed in 2013:

- **Mississippi:** Additional wetlands habitat was created for migrating and wintering waterfowl and shorebirds.
- **Texas:** Kemp's ridley sea turtle nests and eggs were located and protected.
- **Florida waters:** Seagrass beds damaged by response vessels were repaired and stabilized to help prevent additional injury.

RESTORE Act and Oil Pollution Act

The 2012 RESTORE Act dedicates 80 percent of any civil and administrative penalties related to the Deepwater Horizon accident to a trust fund for ecosystem restoration, economic recovery and tourism promotion.

This is in addition to the restoration of natural resources injured as a result of the accident, which is accomplished through the NRDA and restoration process established by the Oil Pollution Act of 1990.[106]

Managing, analyzing and sharing data

BP is sharing a sizable collection of environmental data with the academic community and the public at http://gulfsciencedata.bp.com. These data can help researchers who are trying to understand conditions in the Gulf before, during and after the accident.

http://gulfsciencedata.bp.com

Data facts

775 terabytes
of data

1 million+
environmental samples collected

13 million+
analytical results

10 million+
photographs

Trustees, BP and Coast Guard scientists have collected data ranging from water and sediment chemistry, to bird and fish observations. Data were gathered to guide accident response efforts, remove oil from the environment, assess potential injury to natural resources and develop restoration plans.

Gulfsciencedata.bp.com

To improve access to data and promote scientific research of the Gulf, BP is making response and NRDA data publicly available in an accessible form at http://gulfsciencedata.bp.com. Data are provided without interpretation and in a format that can be used in other studies and research. Each data posting includes a supplemental report that provides additional context, such as timeframe, location, collection, analysis and organization of the data.

BP will continue to post new data to the site once the appropriate validation and quality control reviews have been conducted. The website currently includes data sets on resources such as fish, birds and marine invertebrates, as well as on oil, water and air.

Quality assurance

The collection and analysis process has been thorough and rigorous, with mechanisms in place to ensure proper data collection. For example, scientists use standard operating procedures (SOPs) that govern sampling methodology to assure accurate and consistent results. In addition, for cooperative NRDA studies, trustees and BP scientists agree on how they will collect data and then jointly verify that the SOPs are being followed in the field.

Although much of the NRDA data were collected cooperatively, trustee and BP scientists typically analyze the data independently. Upon arrival at an independent laboratory, a rigorous quality assurance/quality control process ensures the integrity of the samples and the analysis. Most environmental samples are subject to a secure government "chain of custody" protocol from the point of collection to their analyses at laboratories.

Fulfilling our committments to the Gulf

In 2010, BP committed to clean the Gulf shoreline, restore the environment and support economic recovery. Our efforts to meet these commitments have been significant and sustained, with BP spending more than $28 billion.

In addition to cleaning the shoreline and funding environmental restoration projects, BP has paid claims and supported two of the region's most critical industries – tourism and seafood. The region's economic recovery is a reflection of these efforts and a sign of the Gulf's environmental health.

Examples of BP's funding related to Gulf Coast recovery

(as of February 28, 2015)

Response and cleanup	**$14.3 billion**
Claims, advances and settlements	**$13.6 billion**
Funding for the NRDA process	**$1.3 billion**
Early restoration projects	**$698 million***
State-led tourism campaigns	**$179 million**
State-led seafood marketing programs	**$48.5 million**
State-led seafood testing	**$25.4 million**

*$629 million has been provided to the trustees to date.

Family walks a Gulf Coast beach.

Looking ahead

Although we have made tremendous progress in the Gulf, our work is not finished. BP is determined to make good on the commitments the company made to the people who live, work and visit the Gulf, including our pledge to fund environmental restoration.

We will continue to investigate potential environmental injury and share our findings with the public and the scientific community. Five years of scientific investigation have taught us much about the condition and remarkable resilience of the Gulf's environment. We learned that environmental impact was limited in duration and geography, and the injured wildlife and habitat are recovering with no observable long-term population-level impact to any species.

Where reliable science – through the NRDA process – identifies injuries to wildlife or habitat, we will fund restoration of those natural resources and compensate for the temporary loss of use of those resources. The early restoration work underway across the Gulf is allowing recovery to occur earlier in the NRDA process, and is providing data that can help inform the selection of projects for final restoration.

We also remain ready to recover residual Macondo oil under the Coast Guard's direction if additional material is found and requires removal.

We look forward to reporting on our progress in these areas in the future.

Shrimping in Bay Jimmy, La.

Endnotes

[1] "Expert Report of Dr. Damian Shea," August 15, 2014. Web. 6 Mar. 2015. http://www.mdl2179trialdocs.com/releases/release20150120070000O/TREX-013444.pdf

[2] Atlas, R.M. and Hazen, T.C., "Oil Biodegradation and Bioremediation: A Tale of the Two Worst Spills in U.S. History," *Environmental Science & Technology,* June 23, 2011. Web. 6 Mar. 2015. http://pubs.acs.org/doi/abs/10.1021/es2013227

[3] Daling, P.S., et al., "Surface weathering and dispersibility of MC252 crude oil," *Marine Pollution Bulletin,* August, 2014. Web. 6 Mar. 2015. http://www.researchgate.net/publication/265018915_Surface_weathering_and_dispersibility_of_MC252_crude_oil

[4] U.S. Environmental Protection Agency, "General Facts about the Gulf of Mexico." Web. 6 Mar. 2015. http://www.epa.gov/gmpo/about/facts.html

[5] Operational Science and Advisory Team, "Summary Report for Fate and Effects of Remnant Oil in the Beach Environment," February 10, 2011. Web. 6 Mar. 2015. http://www.restorethegulf.gov/sites/default/files/u316/OSAT-2%20Report%20no%20ltr.pdf

[6] American Academy of Microbiology, "Microbes & Oil Spills FAQ," February 2011. Web. 6 Mar. 2015. http://academy.asm.org/images/stories/documents/Microbes_and_Oil_Spills.pdf

[7] Atlas and Hazen, 2011.

[8] NOAA, "Near Shore Submerged Oil Assessment," September 2010. Web. 6 Mar. 2015. http://www.noaa.gov/pdf/NearShoreSubmergedOil%20FINAL.pdf

[9] National Park Service, "Brown Pelican, *Pelecanus occidentalis*." Web. 6 Mar. 2015. http://www.fws.gov/home/feature/2009/pdf/brown_pelicanfactsheet09.pdf

[10] Nomack, M., "Beach-nesting birds of the Gulf of Mexico," *The Encyclopedia of Earth,* September 12, 2010. Web. 6 Mar. 2015. http://www.eoearth.org/view/article/158445/

[11] National Research Council Committee on Oil in the Sea, "Oil in the Sea III: Inputs, Fates, and Effects," 2003. Web. 6 Mar. 2015. http://www.ncbi.nlm.nih.gov/pubmed/25057607

[12] Smith, A.J., Flemings, P.B., Fulton, P.M., "Hydrocarbon flux from natural deepwater Gulf of Mexico vents," *Earth and Planetary Science Letters,* June 2014. Web. 6 Mar. 2015. http://www.sciencedirect.com/science/article/pii/S0012821X14002076

[13] Atlas and Hazen, 2011.

[14] NOAA, "NOAA, Partners Predict an Average 'Dead Zone' for Gulf of Mexico; Slightly Above-Average Hypoxia in Chesapeake Bay," June 24, 2014. Web. 6 Mar. 2015. http://oceanservice.noaa.gov/news/june14/hypoxia-forecast.html

[15] Harte Research Institute, "Overfishing and Bycatch," GulfBase.org, 2004. Web. 6 Mar. 2015. http://www.gulfbase.org/issue/view.php?iid=oab

[16] U.S. Geological Survey, "Louisiana Coastal Wetlands: A Resource at Risk." Web. 6 Mar. 2015. http://pubs.usgs.gov/fs/la-wetlands/

[17] Dubinsky, E.A., et al., "Succession of Hydrocarbon-Degrading Bacteria in the Aftermath of the Deepwater Horizon Oil Spill in the Gulf of Mexico," *Environmental Science & Technology,* 47,19: 10860–10867, 2013. Web. 6 Mar. 2015. http://pubs.acs.org/doi/abs/10.1021/es401676y

[18] Beazley, M.J., et al., "Microbial Community Analysis of a Coastal Salt Marsh Affected by the *Deepwater Horizon* Oil Spill," *PLOS ONE*. July 18, 2012. 7(7): e41305.Doi:10.1371/journal.pone.0041305. Web. 6 Mar. 2015. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0041305

[19] Kostka, J.E., et al., "Hydrocarbon-Degrading Bacteria and the Bacterial Community Response in Gulf of Mexico Beach Sands Impacted by the Deepwater Horizon Oil Spill," *Applied and Environmental Microbiology,* September 23, 2011. 77:7962-7974. Web. 6 Mar. 2015. http://aem.asm.org/content/77/22/7962.full

[20] Chakraborty, R., Borglin, S.E., Dubinsky, E.A., Andersen, G.L., Hazen, T.C., "Microbial response to the MC-252 oil and Corexit 9500 in the Gulf of Mexico," *Frontiers in Microbiology,* October 11, 2012. 3:357-357 (2012). Web. 6 Mar. 2015. http://journal.frontiersin.org/Journal/10.3389/fmicb.2012.00357

[21] Mason, O.U. and Hazen, T.C., "New insights into microbial responses to oil spills from the Deepwater Horizon incident," *SIM News,* May/June 2011.

[22] Operational Science Advisory Team, "Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring," (OSAT-1 Report), December 17, 2010. Web. 6 Mar. 2015. http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf

[23] Operational Science Advisory Team, "Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Ecotoxicity Addendum," (OSAT-1 Addendum), July 8, 2011. Web. 6 Mar. 2015. http://www.restorethegulf.gov/sites/default/files/u306/FINAL%20OSAT%20Ecotox%20Addendum.pdf

[24] Operational Science Advisory Team, "Summary Report for Fate and Effects of Remnant Oil in the Beach Environment, (OSAT-2 Report), February 10, 2011. Web. 6 Mar. 2015. https://www.restorethegulf.gov/sites/default/files/u316/OSAT-2%20Report%20no%20ltr.pdf

[25] Operational Science Advisory Team, "Investigation of Recurring Residual Oil in Discrete Shoreline Areas in the Eastern Area of Responsibility," (OSAT-3 Report for Florida, Alabama, Mississippi), January 15, 2014. Web. 6 Mar. 2015. https://www.restorethegulf.gov/sites/default/files/u372/OSAT%20III%20Eastern%20States.pdf

[26] Operational Science Advisory Team, "Investigation of Recurring Residual Oil in Discrete Shoreline Areas in Louisiana," (OSAT-3 Report for Louisiana), May 2, 2014. Web. 6 Mar. 2015. http://www.restorethegulf.gov/sites/default/files/u371/OSAT-3%20LA%20AOR.pdf

[27] U.S. Geological Survey, "Using Radar to Understand Migratory Birds and Their Habitats: Critical Needs for the Gulf of Mexico." Web. 6 Mar. 2015. http://www.nwrc.usgs.gov/factshts/2005-3067.pdf

[28] Gulf Science Data, see "Live Bird Oiling," tab. Web. 6 Mar. 2015. http://gulfsciencedata.bp.com/go/doc/6145/1944626/

[29] Gulf Science Data, see "Bird Capture, Heath, and Telemetry," tab. Web. 6 Mar. 2015. http://gulfsciencedata.bp.com/go/doc/6145/1944626

[30] Gulf Science Data, see "Colonial Waterbird Productivity Data Collection," "Bald Eagle Productivity Data Collection," and "Osprey Productivity Data Collection," tabs. Web. 6 Mar. 2015. http://gulfsciencedata.bp.com/go/doc/6145/1944626

[31] Noel, L., et al., "Coastal Bird Density in the Northern Gulf of Mexico: May 2010 and May 2011," Society for Environmental Toxicology and Chemistry (SETAC) North America 32nd Annual Meeting, November 2011.

[32] Audubon, "Christmas Bird Count," 2014. Web. 6 Mar. 2015. http://birds.audubon.org/christmas-bird-count

[33] Gulf Science Data, see "Data Inputs for Beached Bird Assessment," tab. Web. 6 Mar. 2015. http://gulfsciencedata.bp.com/go/doc/6145/1944626/

[34] Haney, J.C., Geiger, H.J., Short, J.W, "Bird mortality from the *Deepwater Horizon* oil spill. I. Exposure probability in the offshore Gulf of Mexico," *Marine Ecology,* October 22, 2014. Web. 6 Mar. 2015. http://www.int-res.com/abstracts/meps/v513/p225-237/ and "Bird mortality from the *Deepwater Horizon* oil spill. II. Carcass sampling and exposure probability in the coastal Gulf of Mexico," *Marine Ecology,* October 22, 2014. Web. 6 Mar. 2015. http://www.int-res.com/abstracts/meps/v513/p239-252/

[35] Gulf Science Data, see "Data Inputs for Beached Bird Assessment," tab. Web. 6 Mar. 2015. http://gulfsciencedata.bp.com/go/doc/6145/1944626/

[36] Franci, C.D., et al., "Endocrine status of a migratory bird potentially exposed to the Deepwater Horizon oil spill: A case study of northern

gannets breeding on Bonaventure Island, Eastern Canada," *Science of the Total Environment,* March 1, 2014. 473-474: 110-116. Web. 6 Mar. 2015. http://www.sciencedirect.com/science/article/pii/S0048969713014587

[37] Walter, S.T., Carloss, M.R., Hess, T.J., Leberg, P.L., "Demographic trends of Brown Pelicans in Louisiana before and after the Deepwater Horizon oil spill," *Journal of Field Ornithology,* November 25, 2014. Web. 6 Mar. 2015. http://onlinelibrary.wiley.com/doi/10.1111/jofo.12081/abstract

[38] BP, "Abundance and Safety of Gulf Seafood," September 15, 2014. Web. 6 Mar. 2015. https://www.thestateofthegulf.com/media/1428/seafood-background-white-paper.pdf

[39] "Expert Report of Dr. John W. Tunnell, Jr.," August 15, 2014. Web. 6 Mar. 2015. http://www.mdl2179trialdocs.com/releases/release201501280800007/TREX-013163.pdf

[40] Fodrie, F.J., et al., "Integrating Organismal and Population Responses of Estuarine Fishes in Macondo Spill Research," *BioScience,* September 2014. Web. 6 Mar. 2015. http://bioscience.oxfordjournals.org/content/64/9/778.abstract

[41] NOAA, "Commercial Fisheries Statistics." Web. 6 Mar. 2015. http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/

[42] Nelson, J.R., Bauer, J.R., Rose, K., "Assessment of Geographic Setting on Oil Spill Impact Severity in the United States – *Insights from Two Key Spill Events in Support of Risk Assessment for Science-Based Decision Making," Journal of Sustainable Energy Engineering,* September 2014. Web. 6 Mar. 2015. http://www.ingentaconnect.com/content/scrivener/jsee/2014/00000002/00000002/art00006?crawler=true

[43] Szedlmayer, S.T. and Mudrak, P.A., "Influence of Age-1 Conspecifics, Sediment Type, Dissolved Oxygen, and the Deepwater Horizon Oil Spill on Recruitment of Age-0 Red Snapper in the Northeast Gulf of Mexico during 2010 and 2011," *North American Journal of Fisheries Management,* April 1, 2014. Web. 6 Mar. 2015. http://www.tandfonline.com/doi/abs/10.1080/02755947.2014.882457#preview

[44] Gulf of Mexico Fishery Management Council, "Red Snapper Update," Gulf Fishery News 33(3), June-July 2011. Web. 6 Mar. 2015. http://www.gulfcouncil.org/news_resources/Newsletters/NEWSLTR06-2011.pdf

[45] Fodrie, F.J. and Heck Jr., K.L., "Response of Coastal Fishes to the Gulf of Mexico Oil Disaster," *PLOS ONE,* July 2011. Web. 6 Mar. 2015. http://www.utm.utoronto.ca/~w3bio/bio464/lectures/lectures_assets/fishsurvivalBPspill.pdf

[46] Dubansky, B., et al., "Multitissue molecular, genomic, and developmental effects of the Deepwater Horizon oil spill on resident Gulf killifish *(Fundulus grandis),*" *Environmental Science & Technology,* April 22, 2013. Web. 6 Mar. 2015. http://pubs.acs.org/doi/abs/10.1021/es400458p

[47] Pearson, W.H., "Comment on 'Multitissue molecular, genomic, and developmental effects of the Deepwater Horizon oil spill on resident Gulf killifish *(Fundulus grandis),*'" *Environmental Science & Technology,* June 19, 2014. Web. 6 Mar. 2015. http://pubs.acs.org/doi/abs/10.1021/es405220v

[48] Able, K.W., et al.,"Fish Assemblages in Louisiana Salt Marshes: Effects of the Macondo Oil Spill," *Estuaries and Coasts,* Accepted September 8, 2014. Web. 6 Mar. 2015. https://marine.rutgers.edu/pubs/private/238.pdf

[49] Nelson, T.R., DeVries, D.R., Wright, R.A., Gagnon, J.E., "*Fundulus grandis* Otolith Microchemistry as a Metric of Estuarine Discrimination and Oil Exposure," *Estuaries and Coasts,* Accepted January 8, 2015. Web. 6 Mar. 2015. http://link.springer.com/article/10.1007%2Fs12237-014-9934-y

[50] Moody, R.M., Cebrian, J., Heck, Jr., K.L., "Interannual Recruitment Dynamics for Resident and Transient Marsh Species: Evidence for a Lack of Impact by the Macondo Oil Spill," *PLOS ONE,* March 13, 2013. Web. 6 Mar. 2015. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0058376

[51] Muhling, B.A., et al., "Overlap between Atlantic bluefin tuna spawning grounds and observed Deepwater Horizon surface oil in the northern Gulf of Mexico," *Marine Pollution Bulletin,* April 2012. Web. 6 Mar. 2015. http://www.sciencedirect.com/science/article/pii/S0025326X12000574

[52] International Commission for the Conservation of Atlantic Tuna, "Executive Summary BFTE," Web. 6 Mar. 2015. https://www.iccat.int/Documents/SCRS/ExecSum/BFT_EN.pdf

[53] Brette, F., Machado, B., Cros, C., Incardona, J.P., Scholz, N.L., Block, B.A., "Crude Oil Impairs Cardiac Excitation-Contraction Coupling in Fish," *Science,* February 14, 2014. Web. 6 Mar. 2015. http://www.sciencemag.org/content/343/6172/772.abstract

[54] "Expert Report of Dr. Damian Shea," September 12, 2014. Web. 6 Mar. 2015. http://www.mdl2179trialdocs.com/releases/release201501200700000/TREX-013445.pdf

[55] Southeast Data, Assessment, Review, SEDAR 33 – "Gulf of Mexico Greater Amberjack Stock Assessment Report," March 2014. Web. 6 Mar. 2015. http://www.cio.noaa.gov/services_programs/prplans/pdfs/ID234_SEDAR33_Amberjack_finalworkproduct.pdf

[56] Hart, R.A., "Stock Assessment of Brown Shrimp *(Farfantepenaeus aztecus)* in the U.S. Gulf of Mexico for 2011," NOAA Technical Memorandum NMFS-SEFSC-638. November 2012. Web. 6 Mar. 2015. http://docs.lib.noaa.gov/noaa_documents/NMFS/SEFSC/TM_NMFS_SEFSC/NMFS_SEFSC_TM_638.pdf

[57] Hart, R.A., "Stock Assessment of Pink Shrimp *(Farfantepenaeus duorarum)* in the U.S. Gulf of Mexico for 2011," September 2012. Web. 6 Mar. 2015. http://safmc.net/Meetings/SSCMeeting/SSCBBOctober2012/A6_%20Pink%20Assess_Rpt-CPT-2012.pdf

[58] U.S. FDA, "Gulf Seafood is Safe to Eat after Oil Spill," January 11, 2012. Web. 6 Mar. 2015. http://blogs.fda.gov/fdavoice/?tag=gulf-seafood

[59] U.S. FDA, "NOAA and FDA Announce Chemical Test for Dispersant in Gulf Seafood; All Samples Test Within Safety Threshold," October 29, 2010. Web. 6 Mar. 2015. http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2010/ucm231653.htm

[60] Hart, R.A., "Stock Assessment of White Shrimp *(Litopenaeus setiferus)* in the U.S. Gulf of Mexico for 2011," June 2012. Web. 6 Mar. 2015. http://184.106.97.89/sites/default/files/stock_assessment_of_white_shrimp_litopenaeus_setiferus_in_the_u.s._gulf_of_mexico.pdf

[61] Tunnell, J., 2014

[62] VanderKooy, S., Gulf States Marine Fisheries Commission, "GDAR 01 Stock Assessment Report, Gulf of Mexico Blue Crab," June 2013. Web. 6 Mar. 2015. http://www.gsmfc.org/publications/GSMFC%20Number%20215.pdf

[63] NASA, "Earth Observatory: What are Phytoplankton?" July 13, 2010. Web. 6 Mar. 2015. http://earthobservatory.nasa.gov/Features/Phytoplankton/

[64] LDWF, "Oyster Stock Assessment Report of the Public Oyster Areas in Louisiana," July 2010. Web. 6 Mar. 2015. https://www.wlf.louisiana.gov/sites/default/files/pdf/page_fishing/32695-Oyster%20Program/2010-oyster-stock-assessment-report.pdf

[65] BP, "Oyster White Paper," September 3, 2014. Web. 6 Mar. 2015. http://www.stateofthegulf.com/media/1363/oyster-background-white-paper.pdf

[66] Soniat, T.M., et al., "Chemical and Physiological Measures on Oysters *(Crassostrea virginica)* from Oil-Exposed Sites in Louisiana," *Journal of Shellfish Research,* December 2011. Web. 6 Mar. 2015. http://www.bioone.org/doi/abs/10.2983/035.030.0311

[67] Apeti, D., et al., "Assessing the Impacts of the Deepwater Horizon Oil Spill: The National Status and Trends Program Response, A Summary Report of Coastal Contamination," March 2013, National Centers for Coastal Ocean Science, NOAA Technical Memorandum NOS NCCOS 167.) Web. 6 Mar. 2015. http://aquaticcommons.org/14686/

[68] LDWF, Oyster Stock Assessment, 2010.

[69] LDWF, "Comprehensive Report of the 2010 Oyster Mortality Study in Breton Sound and Barataria Basins," May 2011. Web. 6 Mar. 2015. http://www.wlf.louisiana.gov/sites/default/files/pdf/document/37758-research/ldwf_-_oyster_mortality_study_-_exec_summary_full_report_combined-1.pdf

[70] La Peyre, M.K., Eberline, B.S., Soniat, T.M., La Peyre, J.F., "Differences in extreme low salinity timing and duration differentially affect eastern oyster *(Crassostrea virginica)* size class growth and mortality in Breton Sound, LA," *Estuarine, Coastal and Shelf Science,* December 20, 2013.

Web. 6 Mar. 2015. http://www.sciencedirect.com/science/article/pii/S0272771413004290

[71] NOAA, "Letter to Gov. Phil Bryant, Mississippi," September 12, 2012. Web. 6 Mar. 2015. http://www.nmfs.noaa.gov/stories/2012/09/docs/blank_bryant_9_13_12.pdf

[72] NOAA, "Commerce Secretary Pritzker Declares Fisheries Disaster for Florida Oyster Fishery," August 12, 2013. Web. 6 Mar. 2015. http://www.noaanews.noaa.gov/stories2013/20130812_oysterdisasterdeclaration.html

[73] NOAA, "FAQs on the Ongoing Gulf of Mexico Dolphin Die-off," NOAA Fisheries website. Web. 6 Mar. 2015. http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico_faq.htm

[74] NOAA, "Brucella and 2010-2014 Cetacean Unusual Mortality Event in Northern Gulf of Mexico," NOAA Fisheries website. Web. 6 Mar. 2015. http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010_brucella.htm

[75] MDL2179 Trial Documents. Web. 6 Mar. 2015. http://www.mdl2179trialdocs.com/index.php?page=details&release_id=201501280800007, See TREX 246280-246680

[76] U.S. Fish and Wildlife Service, "Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report," April 20, 2011. Web. 6 Mar. 2015. http://www.fws.gov/home/dhoilspill/pdfs/ConsolidatedWildlifeTable042011.pdf

[77] Schwacke, L.H., et al., "Health of Common Bottlenose Dolphins *(Tursiops truncatus)* in Barataria Bay, Louisiana, Following the *Deepwater Horizon* Oil Spill," *Environmental Science and Technology,* December 18, 2013. Web. 6 Mar. 2015. http://pubs.acs.org/doi/abs/10.1021/es403610f

[78] Jacobs, L.A., "Comment on Health of Common Bottlenose Dolphins *(Tursiops truncatus)* in Barataria Bay, Louisiana, Following the *Deepwater Horizon* Oil Spill," *Environmental Science and Technology,* March 13, 2014. Web. 6 Mar. 2015. http://pubs.acs.org/doi/abs/10.1021/es500134b

[79] U.S. Fish and Wildlife Service, "Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report," April 20, 2011. Web. 6 Mar. 2015. http://www.fws.gov/home/dhoilspill/pdfs/ConsolidatedWildlifeTable042011.pdf

[80] Florida Fish and Wildlife Conservation Commission, "Index Nesting Beach Survey Totals (1989-2014)." Web. 6 Mar. 2015. http://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/

[81] National Park Service, "The Kemp's Ridley Sea Turtle." Web. 6 Mar. 2015. http://www.nps.gov/pais/naturescience/kridley.htm

[82] U.S. Fish and Wildlife Service, "Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report," April 20, 2011. Web. 6 Mar. 2015. http://www.fws.gov/home/dhoilspill/pdfs/ConsolidatedWildlifeTable042011.pdf

[83] NOAA, Lubchenco, J., "Oil Spill Clarifies Road Map for Sea Turtle Recovery," March 2011. Web. 6 Mar. 2015. http://www.nmfs.noaa.gov/mediacenter/docs/2011/mar/oil_spill_clarifies_road_map_for_sea_turtle_recovery.pdf

[84] U.S. Fish and Wildlife Service, "Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report," April 20, 2011. Web. 6 Mar. 2015. http://www.fws.gov/home/dhoilspill/pdfs/ConsolidatedWildlifeTable042011.pdf

[85] Nero, R.W., Cook, M., Coleman, A.T., Solangi, M., Hardy, R., "Using an ocean model to predict likely drift tracks of sea turtle carcasses in the north central Gulf of Mexico," *Endangered Species Research,* September 6, 2013. Web. 6 Mar. 2015. https://www.southeastern.edu/acad_research/depts/biol/dept_seminar/pdf/14b_coleman2.pdf

[86] Michel, J., et al., "Extent and Degree of Shoreline Oiling: *Deepwater Horizon* Oil Spill, Gulf of Mexico, USA," *PLOS ONE,* June 12, 2013, 8(6):e65087.doi:10.1371/journal.pone.0065087. Web. 6 Mar. 2015. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3680451/

[87] U.S. Coast Guard and NOAA, "ERMA Deepwater Gulf Response." Web. 6 Mar. 2015. http://response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-erma/erma-gulf-response.html

[88] Michel, J., et al., 2013.

[89] *Ibid.*

[90] BP, "Gulf Coast Marshes," July 30, 2014.

[91] Silliman, B.R., et al., "Degradation and resilience in Louisiana salt marshes after the BP-*Deepwater Horizon* oil spill," *Proceedings of the National Academies of Sciences of the United States (PNAS),* June 25, 2012. Web. 6 Mar. 2015. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3396483/

[92] "Expert Report of Elliot Taylor, PH.D," August 15, 2014. Web. 6 Mar. 2015. http://www.mdl2179trialdocs.com/releases/release201501200700000/TREX-013246.pdf

[93] Lin, Q., and Mendelssohn, I.A., "Impacts and Recovery of the *Deepwater Horizon* Oil Spill on Vegetation Structure and Function of Coastal Salt Marshes in the Northern Gulf of Mexico," *Environmental Science & Technology,* February 2012. Web. 6 Mar. 2015. http://pubs.acs.org/doi/abs/10.1021/es203552p

[94] Judy, C.R., Graham, S.A., Lin, Q., Hou, A., Mendelssohn, I.A., "Impacts of Macondo oil from *Deepwater Horizon* spill on the growth response of the common reed *Phragmites australis:* A mesocosm study," *Marine Pollution Bulletin,* February 15, 2014. Web. 6 Mar. 2015. http://dx.doi.org/10.1016/j.marpolbul.2013.12.046

[95] Mahmoudi, N., et al., "Rapid degradation of Deepwater Horizon spilled oil by indigenous microbial communities in Louisiana salt marsh sediments," *Environmental Science & Technology,* November 12, 2013. Web. 6 Mar. 2015. http://pubs.acs.org/doi/abs/10.1021/es4036072

[96] Operational Science Advisory Team, "Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring," (OSAT-1 Report), December 17, 2010. Web. 6 Mar. 2015. http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf

[97] Chanton, J., et al., "Using Natural Abundance Radiocarbon to trace the Flux of Petrocarbon to the Seafloor following the Deepwater Horizon Oil Spill," *Environmental Science & Technology,* December 12, 2014. Web. 6 Mar. 2015. http://pubs.acs.org/doi/abs/10.1021/es5046524

[98] Fisher, C.R., et al., "Footprint of *Deepwater Horizon* blowout impact to deep-water coral communities," *PNAS,* August 12, 2014. Web. 6 Mar. 2015. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4136632/

[99] Benfield, M., Louisiana State University, "Presentation at Society for Environmental Toxicology and Chemistry (SETAC)," November 2011.

[100] Gulf Shores and Orange Beach Convention and Visitor's Bureau. Web. 6 Mar. 2015. http://www.agccvb.org/stats/

[101] Smith Travel Research, "Trend Reports." Web. 6 Mar. 2015. http://www.str.com/products/trend-reports

[102] VISIT Florida, "Florida's Tourism Industry Welcomed More Than 97 Million Visitors in 2014," March 3, 2015. Web. 6 Mar. 2015. http://www.visitfloridamediablog.com/home/2015/03/03/floridas-tourism-industry-welcomed-more-than-97-million-visitors-in-2014/

[103] Smith Travel Research, "Trend Reports." Web. 6 Mar. 2015. http://www.str.com/products/trend-reports

[104] The University of New Orleans Hospitality Research Center, "Louisiana Tourism Forecast, 2014 – 2017," April 2014. Web. 6 Mar. 2015. http://www.crt.state.la.us/Assets/Tourism/research/documents/2013-2014/LATourismForecastReport2014-2017.pdf

[105] Mississippi Department of Revenue.

[106] Gulf Coast Ecosystem Restoration Council, "About the RESTORE Act." Web. 11 Mar. 2015. http://www.restorethegulf.gov/about-us/about-restore-act