





Chapter Six

“The worst environmental disaster America has ever faced.”

Oiling a Rich Environment: Impacts and Assessment

When President Barack Obama addressed the nation from the Oval Office on June 15—nearly two months after the Macondo well began gushing crude oil and one month before engineers subdued it—he said:

Already, this oil spill is the worst environmental disaster America has ever faced. And unlike an earthquake or a hurricane, it’s not a single event that does its damage in a matter of minutes or days. The millions of gallons of oil that have spilled into the Gulf of Mexico are more like an epidemic, one that we will be fighting for months and even years.¹

The *Deepwater Horizon* blowout produced the largest accidental marine oil spill in U.S. history,² an acute human and environmental tragedy. Worse still, as discussed in Chapter 7, it occurred in the midst of environmental disasters related to land-based pollution and massive destruction of coastal wetlands—chronic crises that proceed insidiously and will require not months but decades of national effort to address and repair.

A lone beachgoer encounters bands of oil along Alabama’s Orange Beach. Though wind and currents helped keep most of the spilled oil offshore, all told some 650 miles of Gulf Coast habitat were oiled to one degree or another—Louisiana was hardest hit—impacting ecosystems, the economy, and human health.

< Tyrone Turner/Photo courtesy of National Geographic

Laws guide resolution of damages from the spill itself. There is a suite of policies and programs aimed at improving discrete environmental issues within the Gulf and along its coast. The law also provides compensation for direct economic impacts. This chapter analyzes these immediate impacts, not only on the natural environment but also on the economy and on human health in the affected region. Unfortunately, the human-health effects are the least-recognized fallout from the spill, and those least-well addressed in existing law and policies.

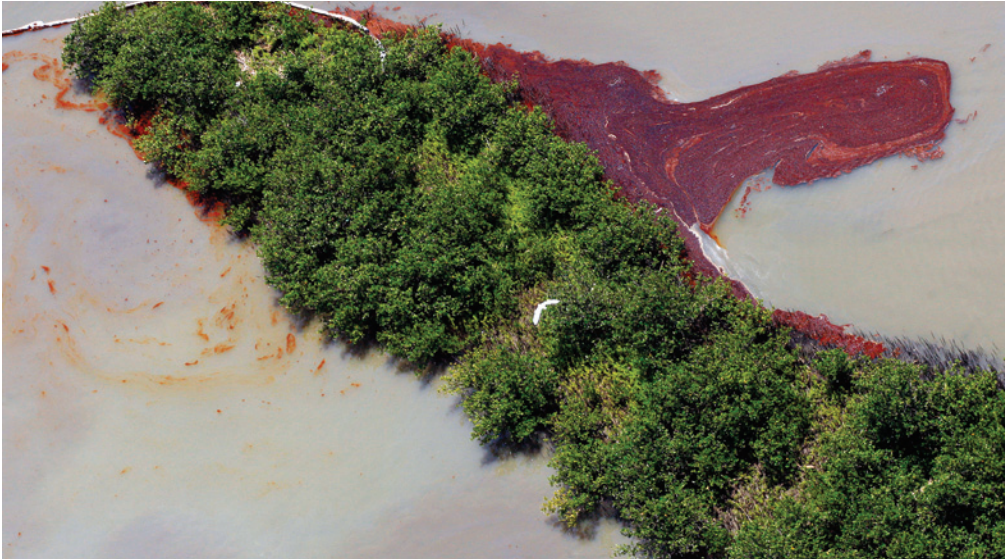
The Impact on Nature

The *Deepwater Horizon* oil spill immediately threatened a rich, productive marine ecosystem. To mitigate both direct and indirect adverse environmental impacts, BP and the federal government took proactive measures in response to the unprecedented magnitude of the spill.³ Unfortunately, comprehensive data on conditions before the spill—the natural “status quo ante” from the shoreline to the deepwater Gulf—were generally lacking.⁴ Even now, information on the nature of the damage associated with the released oil is being realized in bits and pieces: reports of visibly oiled and dead wildlife, polluted marshes, and lifeless deepwater corals. Moreover, scientific knowledge of deepwater marine communities is limited, and it is there that a significant volume of oil was dispersed from the wellhead, naturally and chemically, into small droplets.⁵ Scientists simply do not yet know how to predict the ecological consequences and effects on key species that might result from oil exposure in the water column, both far below and near the surface.⁶

Much more oil might have made landfall, but currents and winds kept most of the oil offshore, and a large circulating eddy kept oil from riding the Loop Current toward the Florida Keys.⁷ Oil-eating microbes probably broke down a substantial volume of the spilled crude, and the warm temperatures aided degradation and evaporation⁸—favorable conditions not present in colder offshore energy regions.⁹ (Oil-degrading microbes are still active in cold water, but less so than in warmer water.) However widespread (and in many cases severe) the natural resource damages are, those observed so far have fallen short of some of the worst expectations and reported conjectures during the early stages of the spill.¹⁰ So much remains unknown that will only become clearer after long-term monitoring of the marine ecosystem. Government scientists (funded by the responsible party) are undertaking a massive effort to assess the damages to the public’s natural resources. Additionally, despite significant delays in funding and lack of timely access to the response zone, independent scientific research of coastal and marine impacts is proceeding as well.

A rich marine ecosystem. Particularly along the Louisiana coast, the Gulf of Mexico is no stranger to oil spills.¹¹ But unlike past insults, this one spewed from the depths of the ocean, the bathypelagic zone (3,300–13,000 feet deep). Despite the cold, constant darkness and high pressure (over 150 atmospheres), scientists know that the region has abundant and diverse marine life. There are cold-water corals, fish, and worms that produce light like fireflies to compensate for the perpetual night. Bacteria, mussels, and tubeworms have adapted to life in an environment where oil, natural gas, and methane seep from cracks in the seafloor. Endangered sperm whales dive to this depth and beyond to feed on giant squid and other prey.¹²

Elmer's Island in Grand Isle, La.



A dark tongue of oil invaded sensitive wetlands last May near Grand Isle, Louisiana, despite the presence of booms deployed to stop it. In a hopeful development over the summer, scientists found new plant growth in similarly oiled marshes, indicating that oil had not penetrated into root systems.

Patrick Semansky/Associated Press

Higher up the water column, light and temperature gradually increase and the ascending sperm whales—and Macondo well oil—encounter sharks, hundreds of fish species, shrimp, jellyfish, sea turtles, and dolphins. As the sperm whales surface for air at the bright and balmy Gulf surface, they pass through multitudes of plankton, floating seaweed beds, and schools of fish. Some of these fish species spend their early lives in the coastal waters and estuaries; others travel along annual migration routes from the Atlantic Ocean to the Gulf. The floating seaweed beds (sargassum), fish larvae, and plankton drift with the surface currents and are driven by the wind—as is the oil rising from below. The critical sargassum habitats lure sea turtles, tuna, dolphins, and numerous game fish to feed on the snails, shrimp, crabs, and juvenile species that seek shelter and food in the seaweed.¹³

Overhead are multitudes of seabirds—among them brown pelicans, northern gannets, and laughing gulls—that in turn feed in the ocean and coastal estuaries.¹⁴ Dozens of bird species fly the Mississippi migration route each year, a major attraction for bird watchers, who flock to coastal Louisiana and Texas to catch a glimpse of migrating and resident shorebirds and nesting seabirds. Some of these birds feed on estuarine shrimp, fish, and crabs; others depend on shellfish and other small organisms that populate the expansive mudflats. Larger wading birds stalk their prey in the shallow water of mangroves, marshes, and other habitats that shelter fish and frogs. Raptors, including ospreys, bald eagles, and peregrine falcons, also pluck their prey from any of these environments and carry it to their perches.

As the unprecedented volume of oil gushing from the Macondo blowout reached the surface, it had the potential to affect all of these marine and coastal organisms and to wash into the salt marshes, mudflats, mangroves, and sandy beaches—each in its way an

Oiled Sargassum



Wildlife biologist Mark Dodd surveys a raft of oil-soaked sargassum, also known as gulfweed. The floating beds are home to snails, shrimp, crabs, and other small creatures that—oiled or not—are ingested by turtles, dolphins, tuna, and game fish.

Blair Witherington/FWC

essential habitat at one or more stages of many species' lifecycles.¹⁵ And these marine and coastal species are so interdependent that a significant effect on any one has the potential to disturb several existing populations in this complex food web.¹⁶

Encountering oil. Organisms are exposed to oil through ingestion, filtration, inhalation, absorption, and fouling.¹⁷ Predators may ingest oil while eating other oiled organisms or mistaking oil globules for food. Filter feeders—including some fish, oysters, shrimp, krill, jellyfish, corals, sponges, and whale sharks—will ingest minute oil particles suspended in the water column. Surface-breathing mammals and reptiles surrounded by an oil slick may inhale oily water or its fumes. Birds are highly vulnerable to having their feathers oiled, reducing their ability to properly regulate body temperature.¹⁸ Moderate to heavy external oiling of animals can inhibit their ability to walk, fly, swim, and eat. Similarly, oiling of plants can impede their ability to transpire and conduct photosynthesis, and oiling of coastal sediments can smother the plants they anchor and the many organisms that live below.

Americans watched as the oil eventually came to rest along intermittent stretches of the Gulf coast. Before it arrived, scientists rushed to collect crucial baseline data on coastal and water-column conditions. Some of the oil propelled up from the wellhead was dispersed by natural and chemical means (as described in Chapter 5), creating a deep-ocean plume of oil droplets and dissolved hydrocarbons.¹⁹ A portion of the oil that rose to the surface was also naturally and chemically dispersed in the shallow water column.²⁰

The oil that made landfall was fairly “weathered,” consisting of emulsions of crude oil and depleted of its more volatile components. More than 650 miles of Gulf coastal habitats—

salt marsh, mudflat, mangroves, and sand beaches—were oiled; more than 130 miles have been designated as moderately to heavily oiled. Louisiana’s fragile delta habitats bore the brunt of the damage, with approximately 20 additional miles of Mississippi, Alabama, and Florida shorelines moderately to heavily oiled.²¹ Light oiling and tar balls extended east to Panama City, Florida. Except for occasional tarballs, *Deepwater Horizon* oil never reached Texas or the tourism centers along the southwest Florida coast.²²

Assessing the mixture of oil and life at the water’s edge. The most biologically productive area along a sandy beach occurs where seaweed and other organic materials wash up just above the high tide line in the “wrack zone.” Here, shorebirds forage for insects and other small organisms. As oil moves onto a beach with the rising tide, it is deposited in the wrack zone. Removing oiled wrack is the most prudent means of removing the oil—but doing so removes the living community, too. As the response to the spill proceeded, the Audubon Society evaluated wrack density along shorelines; it found that the wrack density on beaches east of the Mississippi River, where cleanup activities occurred, was “nearly absent,” indicating “diminished habitat quality.”²³

Few beachgoers realize that millions of microscopic organisms live in the Gulf’s soggy sands between high and low tide. By comparing samples taken before and after beaches were oiled, Holly Bik of the University of New Hampshire’s Hubbard Center for Genome Studies, together with scientists at Auburn University and the University of Texas, hopes to determine the impact on this understudied community of sediment-dwelling microfauna.²⁴

Tidal mudflats, generally devoid of vegetation and exposed at low tide, are more sensitive to pollutants than beaches.²⁵ The Louisiana delta and the estuarine bays of Mississippi and Alabama have large expanses of tidal mudflats, which support dense populations of burrowing species (vulnerable to smothering), foraging birds, crabs, and other organisms.²⁶ As oil settles on the flats, crabs and other burrowing animals help mix the oil into the sediment layer (an ecological process called bioturbation), extending the potential damage below the surface.²⁷

Salt marsh and mangroves are both highly productive and sensitive habitats. Marsh grasses tolerate surface coating by weathered oil fairly well, but they will die if oil penetrates the saturated sediments and is absorbed by the root system.²⁸ When that happens, the plants’ root systems degrade, making the marsh much more susceptible to erosion and threatening the habitat on which a wide variety of animals depend. People and equipment deployed in response to the spill can themselves damage the marsh; for example, summer storms pushed boom (used to corral waterborne oil) deep into the marshes, from which it could only be removed by intrusive methods that caused additional harm to the marsh topography.²⁹ Scientists working in oiled marshes observed new plant growth during the summer of 2010—a positive sign that oil had not penetrated into the rich, organic soils and inhibited root systems.³⁰ Professor Eugene Turner of Louisiana State University’s Coastal Ecology Institute plans to study the effects of oil on the local salt marshes for at least the next year. His preliminary observations, through the fall of 2010, indicate some stress resulting in loss of marsh along its edge, but the estimated loss “pales

in comparison” to the annual loss associated with dredging and flood protection (described in Chapter 7).³¹

The marine impacts. When water temperatures warm in the late spring, female oysters release millions of eggs into the water column. The timing of the Macondo oil spill may have been detrimental to oyster reproduction and the spawning of many other species.³² Submerged oil floating in the nearshore water column poses potential threats to diverse shellfish and fish species. Although the impacts are not yet known, the presence of oil in the nearshore environment has been documented. Oil that reached the Gulf’s estuarine waters forced closures of and likely damaged substantial tracts of Louisiana oyster beds.³³ Oyster mortality observed in the highly productive areas of Barataria Bay and Breton Sound, estuaries that flank the lower Mississippi River, appear to be due, in large part, to the flood of fresh water introduced through river diversions in what many believe was a futile attempt to keep oil from entering the estuarine areas.³⁴

Beyond their commercial import, oysters are a keystone species—an organism that exerts a shaping, disproportionate influence on its habitat and community.³⁵ A single adult oyster can filter more than one gallon of water per hour, effectively removing impurities—including oil—from the water column.³⁶ Oyster reefs established on an estuary’s muddy bottom can increase the surface area fifty-fold, creating intricate habitats for crabs, small fish, and other animals, which in turn sustain larger species.³⁷

Harriet Perry, Director of the Center for Fisheries Research and Development at the University of Southern Mississippi, and scientists at Tulane University are studying the potential effects of oil on larvae of blue crabs, another keystone species. The slick from the Macondo oil spill ultimately covered about 40 percent of the offshore area used by larvae of the northern Gulf’s estuarine-dependent species.³⁸ The Gulf coast’s blue crab population had already declined considerably during the past 8 to 10 years as a result of a regional drought.³⁹ Perry and other scientists raced to take samples before the oil arrived and then after, hoping to be able to separate the oil-related impacts on wildlife from climate-related changes.⁴⁰

Many large fish species are dependent on the health of the estuarine and marine habitats and resources. The National Oceanic and Atmospheric Administration (NOAA) noted that species with “essential fish habitat”⁴¹ near the oil spill include scalloped hammerhead, shortfin mako, silky, whale, bigeye thresher, longfin mako, and oceanic whitetip sharks; and swordfish, white marlin, blue marlin, yellowfin tuna, bluefin tuna, longbill spearfish, and sailfish. Other important Gulf fish include red snapper, gag grouper, gray triggerfish, red drum, vermilion snapper, greater amberjack, black drum, cobia and dolphin (mahimahi); coastal migratory open-water species, such as king and Spanish mackerel; and open-water sharks.⁴²

Oil in the water column affects fish and other marine organisms through dermal contact, filtration, or ingestion. How much oil they accumulate depends on its concentration in food, water, and sediments they encounter, time and exposure, and the characteristics of each species—particularly the extent of their fatty tissue. Although oil is not very soluble

Voices from the Gulf

“I have to make house payments and boat payments.”



Claire Luby

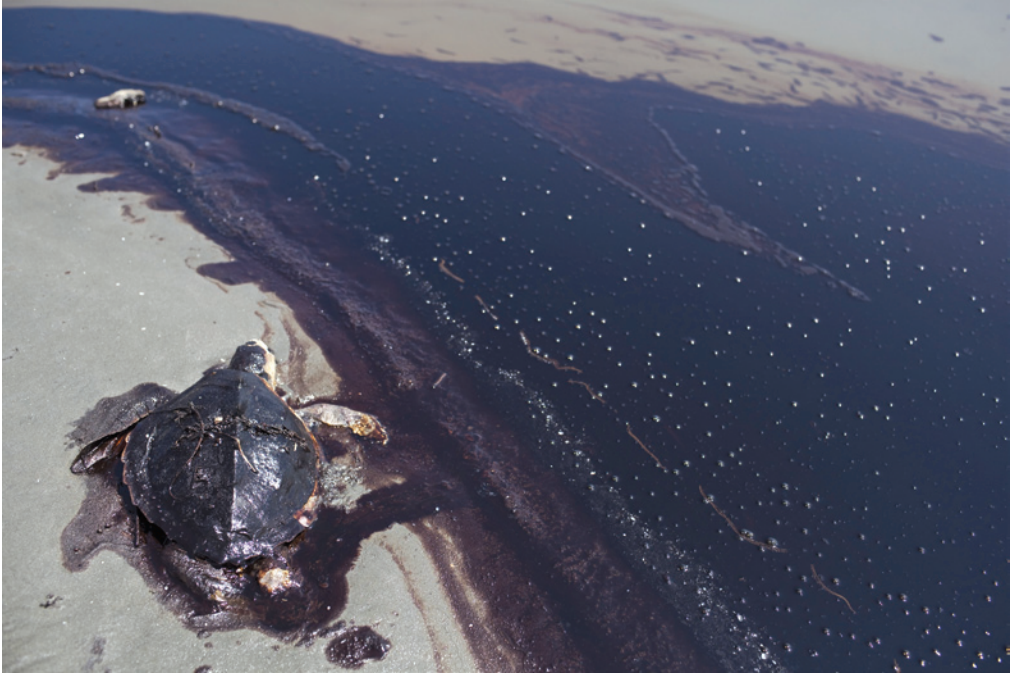
Ve Van Nguyen, Oysterman, Buras, LA

Ve Van Nguyen was an oysterman working for one of the suppliers to P&J Oyster Company. A Vietnamese refugee who fled his homeland with his wife and young family in a boat in 1978, Van Nguyen had made it to the United States. He eventually settled in Buras, located in Plaquemines Parish in 1983, joining a large Vietnamese and Cambodian community that found limited

English skills no impediment to earning a living fishing and shrimping. He had been a fisherman in Vietnam, and as he explained in his native language, “I grew up near the sea and I’m used to eating seafood. I wanted to live where there’s lots of seafood.” He and his wife had both worked on the water, and in recent years they had purchased two specially outfitted oystering boats, in addition to two other boats used for gill fishing. They had loans to repay. In 2009, when they had \$80,000 in income from harvesting oysters, that was not a problem. Their four children were grown, with one still at home.

When Van Nguyen heard on television about the oil spill, he recalls, “I felt that I was going crazy and was really worried that I can’t work anymore. I was afraid that the oil would spread and people can’t eat what we catch so I wouldn’t be able to work. So I was going through a mental crisis.” Louisiana has about 25,000 Vietnamese Americans.

All through May, the Macondo well gushed oil as the government was closing Louisiana oyster beds. Ve Van Nguyen and his wife both found interim work using their boats to install booms against the spreading oil slicks, as part of BP’s clean up. But he made nowhere near as much money as he would have harvesting oysters. Like so many others around the Gulf, he said, “I worry about myself and my wife. I don’t know how we can make it.” He had received some BP payments, but wondered how long those would go on? “I have to make house payments and boat payments.” At age 60, he was no longer young, but certainly expected to continue oystering. But now, if BP does not compensate him for an amount similar to the lost income, “I can’t do anything except for applying for welfare and food stamps.” He had had his four boats towed back to his house. The future? “Everyone is worried and scared about that. They are scared of poisoning so we have to rely on the government to take care of it. I don’t know what will happen.”

Turtle in East Grande Terre Island, LA

Sad testament to the spill, a sea turtle lies dead beside the black tide that took its life along East Grand Terre Island in Louisiana. As of November 2010, the carcasses of more than 600 of the endangered reptiles had been collected. Countless others undoubtedly perished.

Benjamin Lowy/Edit by Getty Images

in water, oil and lipids do mix very well, so high concentrations of petroleum can be found in the fat-rich tissues of the liver, brain, kidneys, and ovaries. Muscle generally has the lowest lipid concentrations, but fish with fatty flesh can accumulate more oil than leaner species.⁴³ Oil constituents can be transferred through the food chain: heavier hydrocarbons can be passed from water to phytoplankton and then to zooplankton, or from sediments to polychaete worms and eventually to fish.⁴⁴ Because animals that are several steps up the food chain, like small fish, have the capability to metabolize hydrocarbons fairly rapidly, their predators will actually not accumulate much from eating them. Accordingly, bioaccumulation of toxic oil components does occur in fish, but biomagnification, with increasingly higher concentrations in animals at each level, does not occur.⁴⁵

It would be impossible to sample and assess each of the thousands of marine fish and other species inhabiting the open-ocean water column. But scientists monitoring the spill along the shorelines and aboard research vessels have sampled plankton, shellfish, fish, water, sediment, and other environmental media to better understand the potential impacts on all terrestrial and marine organisms.⁴⁶ Tens of thousands of samples have been collected. They will likely analyze the samples to determine concentrations of oil and dispersants, and combine that information with existing data on species populations and distributions to model the potential impact of contamination in the water column on different species. In addition, large fish—like bluefin tuna and whale sharks (the world's largest fish)—mammals, and turtles are being tagged with tracking devices so scientists can follow

their movements in the hope of learning how they have been affected by the spill.⁴⁷ By overlaying maps of the extent of the oil spill, derived from satellite images from the European Space Agency, with simulations of bluefin tuna spawning grounds and models of larval development, the Ocean Foundation estimated that the spill could have affected 20 percent of the 2010 season's population of bluefin tuna larvae, further placing at risk an already severely overfished species.⁴⁸

Birds, mammals, turtles. Oiled birds are often the most visually disturbing and widely disseminated images associated with a major oil spill—as in the landmark Santa Barbara accident of 1969.⁴⁹ Through November 1, 2010, wildlife responders had collected 8,183 birds, 1,144 sea turtles, and 109 marine mammals affected by the spill—alive or dead, visibly oiled or not.⁵⁰ Given the effects of hiding, scavenging, sinking, decomposition, and the sheer size of the search area, many more specimens were not intercepted.⁵¹ Therefore, scientists will assess the estimated total damage by applying a multiplier to the final observed number of casualties, and will likely issue separate estimates of sub-lethal effects and the impact of the spill on future populations.

In September 28 testimony before the Commission, Jane Lyder, Deputy Assistant Secretary of the Department of the Interior for Fish and Wildlife and Parks, said that “With more than 60 percent of the data verified, the three most affected [bird] species appear to be Brown Pelicans, Northern Gannets, and Laughing Gulls.” She added that “The fall migration is underway. Songbirds and shorebirds began their migration to the Gulf coast in July. Waterfowl began arriving in late August and early September. We know there are significant impacts to marsh and coastal wetland habitats along sections of the Louisiana coast, particularly near Grand Isle, Louisiana. We are continuing to monitor what the full impact will be to migratory birds and other wildlife.”⁵²

The potential impact on marine mammals and sea turtles is harder to assess. Tim Ragen, Executive Director of the federal Marine Mammal Commission, testifying before a House of Representatives subcommittee on June 10, 2010, could only conclude, “Unfortunately, the scientific foundation for evaluating the potential effects of the *Deepwater Horizon* spill on many marine mammals inhabiting the Gulf is weak.”⁵³

According to NOAA, “Of the 28 species of marine mammals known to live in the Gulf of Mexico, all are protected, and six (sperm, sei, fin, blue, humpback and North Atlantic right whales) are listed as endangered under the Endangered Species Act.” Also of note, “At least four species of threatened/endangered sea turtles (Kemp’s ridley, green, leatherback, and loggerhead) are residents of the northern Gulf of Mexico and are represented by all life stages. A fifth species, the hawksbill turtle, can be found in the southern Gulf. The only nesting beaches in the world for Kemp’s ridley turtles are in the western Gulf of Mexico.”⁵⁴ As of November 1, the Unified Area Command reported that nine marine mammals had been collected alive (and three were released).⁵⁵ One hundred mammals were collected dead, though only four of those were visibly oiled. Most of the marine mammal mortalities were bottlenose dolphins.⁵⁶ Also among the dead was one juvenile sperm whale; it was found floating more than 70 miles from the source of the spill, reportedly unoiled.⁵⁷ More than 600 dead sea turtles were collected.⁵⁸

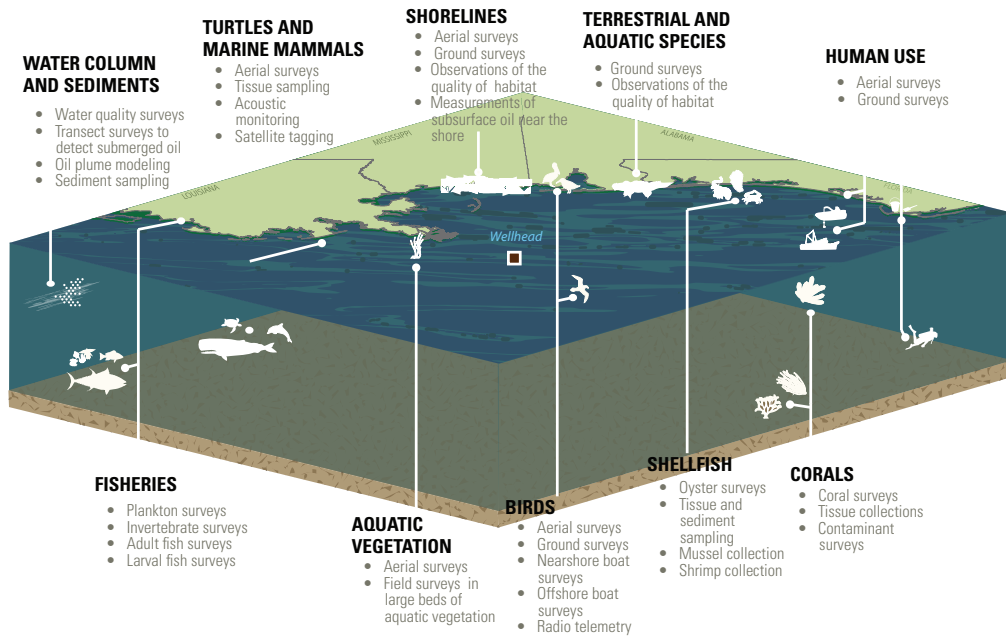
Deepwater plumes of dispersed oil. The highly visible damage to wildlife aside, public and scientific concern about the *Deepwater Horizon* spill—at unprecedented water depths—has for some time focused on the impacts of an invisible subsurface “plume,” or more accurately “clouds” of minute oil droplets moving slowly over the seabed. As of November 2010, three independent, peer-reviewed studies⁵⁹ confirmed the presence of a deepwater plume of highly dispersed oil droplets and dissolved gases at between 3,200 and 4,200 feet deep and extending for many miles, primarily to the southwest of the wellhead.

How will such substances affect the deepwater environment? One concern centered on decomposition and the resulting depletion of the oxygen supply on which aquatic species depend. Bacterial decomposition begins quickly for the light hydrocarbon gases, propane and ethane, but more slowly for the heavier hydrocarbons typically present in a liquid form and for the predominant gas, methane. The blooms of bacteria stimulated by lighter hydrocarbons prime the populations for degradation of other hydrocarbons. The degradation rates are sufficient to reduce the dissolved oxygen concentrations in the plume, but not to harmfully low levels associated with dead zones, where aquatic species cannot survive.⁶⁰ Subsequent mixing with adjacent, uncontaminated waters by slow-flowing currents appears to have been sufficient to prevent any further depletion of dissolved oxygen in the aging plumes.⁶¹ These findings do not rule out potential impacts of deepwater oil and dispersant concentrations on individual species.⁶² Chemical analyses of water samples taken from the established deepwater plume in May 2010 suggest that hydrocarbon concentrations were high enough at the time to cause acute toxicity to exposed organisms,⁶³ although concentrations declined over several miles from the well as the plume mixed with the surrounding water.

Federal scientists have estimated that about 15 percent of the oil escaping the wellhead was physically dispersed by the fluid turbulence around the flow of oil and gas. The deepwater plume would have formed even if chemical dispersants had not been injected at the wellhead. But the addition of 18,379 barrels of dispersants to the discharging oil and gas stream may have increased the volume of oil in the deepwater plumes to a degree comparable to that from physical dispersion alone.⁶⁴ As of late 2010, there have been unconfirmed reports of oil deposited on the seafloor in the vicinity of the Macondo well.⁶⁵ If confirmed by chemical analyses, this would not be particularly surprising because oil droplets can become entrained in denser particulate matter, including the flocks of organic matter (referred to by scientists as “marine snow”) that characterize open-ocean waters, and settle on the ocean floor. There have also been recent reports of dead or dying deepwater corals living on rock outcrops that could have been impinged by the deep plumes.⁶⁶

Because the *Deepwater Horizon* spill was unprecedented in size, location, and duration,⁶⁷ deepwater ecosystems were exposed to large volumes of oil for an extended period. It will take further investigation and more time to assess the impacts on these ecosystems, their extent and duration. Unfortunately, except for studies that have focused on rare and specialized communities associated with rocky outcrops or seeps, scientific understanding of the deepwater Gulf ecosystem has not advanced with the industrial development of deepwater drilling and production.⁶⁸

Figure 6.1: Assessment Categories for Natural Resource Damage Assessment



This figure represents the various natural resource categories being assessed as part of the Deepwater Horizon Natural Resource Damage Assessment. Such an assessment, which always follows an oil spill, is used to make the public whole for ecological damages caused by a spill. This graphic illustrates the three-dimensional challenges that an assessment of a deep sea blowout presents.

NOAA (adapted)

Natural Resource Damage Assessment

The federal Oil Pollution Act (OPA or the Act) creates a process for assessing the damages caused by an oil spill and then the expenditure of monies collected to address those damages. To that end, the Act formally designates “natural resource trustees,” who are responsible for assessing the “natural resources damages” of the spill.⁶⁹ (Figure 6.1) The trustees accordingly prepare a “natural resource damage assessment” that seeks to quantify oil-spill damages to: (1) public natural resources; (2) the services they provide (e.g., oysters provide water filtration); and (3) the public’s lost use of those resources.⁷⁰ For the Macondo spill, NOAA and the Department of the Interior are leading the effort as trustees on behalf of the federal government.⁷¹ The Department of Defense will also participate on behalf of affected military property along the Gulf coast.⁷² The federal representatives will be joined by natural resource trustees from the five Gulf States.⁷³

Identifying and quantifying damages, particularly where complex ecosystems are involved, present enormous challenges. Developing sound sampling protocols that cover adequate time scales, teasing out the effects of other environmental disturbances, and scaling the damages to the appropriate restoration projects often takes considerable time. A typical damage assessment can take years. Two sets of determinations—one concerning the baseline conditions against which damages to each species or habitat will be assessed and

another concerning the quantification of those damages—are particularly difficult and consequential in terms of the overall results.

The goal of a natural resource damage assessment is “to make the environment and public whole for injuries to natural resources and services resulting from [an oil spill].”⁷⁴ The injury is quantified by reference to baseline conditions: “the condition of the natural resources and services that would have existed had the incident not occurred.”⁷⁵ But making this determination is often inherently difficult and highly contentious. Without well-established baseline conditions, there can be inaccurate quantification of damages or required restoration. Given that the ecological baseline can vary seasonally, annually, and over much longer time scales, it can be difficult to pinpoint the exact condition of an ecosystem prior to a spill. Because long-term historical data are often nonexistent or discontinuous, natural resource trustees are likely to be disadvantaged by a lack of sufficient information to fully characterize the condition of relevant ecosystems prior to the incident in question.⁷⁶

As OPA regulations indicate, “baseline” for purposes of damage assessment is generally considered to be the condition of the resource just prior to the spill.⁷⁷ The precise application of this definition has particular importance in the Gulf of Mexico context, where many coastal habitats have been substantially degraded over decades—even centuries—under the pressure of ever-expanding industrial, commercial, and residential development. The natural resource damage assessment regulations, as generally applied, require that BP and other potentially responsible parties restore Gulf resources to their functioning level as of April 19, 2010—by which point the Gulf ecosystem in April 2010 was already weakened.⁷⁸ In this context, effective long-term restoration will require the stabilization and eventual reversal of a number of long-standing, damaging trends.

The effort to thoroughly address the ecological impacts of this historic pollution event is unprecedented in scale. Thousands of samples have been collected from dozens of research cruises. Hundreds of miles of coastline have been observed and sampled.⁷⁹ Marine mammals and turtles are being observed aerially and monitored by satellite or radio tracking devices.⁸⁰ The assessment of natural resources damages is the largest and most complex that the government has ever undertaken to assess oil spill impacts.

Supporting independent scientific research. Apart from these governmental efforts, independent scientists have also sought to study the spill’s impacts. But funding for academic and other scientists in the days and weeks immediately after the spill was limited.⁸¹ As a result, the nation lost a fleeting opportunity to maximize scientific understanding of how oil spills—particularly in the deep ocean—adversely affect individual organisms and the marine ecosystem. Such research depends on sampling, measurements, and investigations that can be accomplished only during and right after the spill. The National Science Foundation tried to fill the gap by funding studies under its Grants for Rapid Response Research (RAPID) Program, aimed at better understanding potential impacts to coastal and marine habitats and resources.⁸² Through September 2010, the Foundation funded 167 *Deepwater Horizon* research projects totaling \$19.4 million.⁸³ The Foundation became practically the sole provider of emergency funding for independent

scientists as the disaster unfolded. Nevertheless, the Program was not a panacea—because individual RAPID grants cannot exceed \$200,000 per year, many scientists were left to seek additional funding to pay for the necessary, costly chemical analyses of their environmental samples.

In May, BP committed to provide \$500 million for independent research on ecosystem assessment, impacts, and recovery efforts. Unfortunately, for multiple procedural and political reasons, by late November 2010 BP had only allocated a small portion of that money.⁸⁴ BP has since announced that it intends to work through the Gulf of Mexico Alliance, an organization led by the five Gulf coast governors, to implement this research program.⁸⁵ Here too, meaningful scientific inquiry will need to include long-term monitoring of the impacts of the spill on the Gulf's marine and coastal ecosystems.

With numerous studies under way through both the government's damage-assessment process and independent scientific research, the published literature regarding environmental impacts from the Macondo blowout can be expected to grow substantially. Major research commitments, totaling hundreds of millions of dollars, have already been made.⁸⁶

Economic Impacts

The *Deepwater Horizon* oil spill put at risk two enormous economic engines that rely on it. Tourism and fishing, the industries affected as collateral damage, were highly sensitive to both direct ecosystem harm and, indirectly, public perceptions and fears of tainted seafood and soiled beaches. For this reason, whatever uncertainty may exist about the immediate and long-term adverse environmental impacts of the oil spill, no such uncertainty exists in terms of the significant adverse economic effects—especially from loss of confidence in commercial fishing.⁸⁷ The Gulf coast's economy depends heavily on commercial fisheries, tourism, and energy production⁸⁸—each directly and immediately affected by the oil gushing from the Macondo well. Federal and state closures of commercial fisheries—a precautionary public-health measure—at once suspended much of the fishing and processing industry;⁸⁹ public concern nationwide that seafood was not safe to eat further compounded the economic impact along the Gulf.⁹⁰ Similarly, public perception that otherwise clean beaches were, or would become, oiled or that air quality during peak vacation season was impaired led to declines in hotel bookings, restaurant seatings, and a wide array of coastal activities.⁹¹ Claims for losses have been submitted by real-estate agents and developers,⁹² fishing charters,⁹³ and even an Alabama dentist who alleged a loss of summer customers.⁹⁴ And the Gulf oil and gas industry, its workers, and the regional economy were affected as the federal government imposed a moratorium (described in Chapter 5) on deepwater drilling intended to prevent another disastrous spill while the causes and consequences of the blowout were evaluated.⁹⁵

That BP agreed to place in escrow a \$20 billion fund to help address financial losses, at President Obama's urging, indicates the magnitude of the economic impact from the loss of control of this one deepwater well.⁹⁶ In its first eight weeks of operation, as of November 23, the independently administered Gulf Coast Claims Facility had paid out more than \$2 billion to approximately 127,000 claimants.⁹⁷ By comparison, during its two-year

Figure 6.2: Annual Tourism & Fishing Revenue: Economic Activity by County

Source: 2007 U.S. Economic Census

Note: Tourism includes: sporting goods stores, scenic/sightseeing transport (water), fishing clubs/guides, hunting/fishing reserves, camps, boat rentals, hotels, casinos, and nature parks. Fishing includes: finfish, shellfish, other seafood, canning, frozen seafood, seafood markets and wholesalers.

lifespan, the September 11th Victim Compensation Fund awarded just over \$7 billion to 5,560 individual claimants.⁹⁸

It is currently not clear, however, the extent to which the enormous indirect economic impacts associated with loss of consumer confidence and injuries to the Gulf coast “brand” will ultimately be deemed compensable and that resulting uncertainty has generated intense debate among diverse government entities, local communities, interest groups, and BP. The federal Oil Pollution Act, for instance, does expressly recognize the appropriateness of compensation for “loss of profits or impairment of earning capacity resulting from property loss or natural resource injury.”⁹⁹ But there is no easy legal answer to the question of how closely linked those lost profits or earnings must be to the spill before they should be deemed compensable. The search for such a rational endpoint for liability has already stymied the Gulf Coast Claims Facility in its processing of claims.¹⁰⁰ The absence of clear and fair procedures for systematically evaluating such claims deserves focused attention as the lessons from the *Deepwater Horizon* oil spill are learned.

The major industries in the “hardest working basin.” Florida State University oceanographer Ian McDonald has called the Gulf of Mexico “the hardest working of our ocean basins.”¹⁰¹ The southern coast of the United States produces more than one-third

of the nation's domestic seafood supply,¹⁰² including most of the shrimp, crawfish, blue crabs, and oysters.¹⁰³ It produces one-third of all domestic oil,¹⁰⁴ and claims four of the top seven trading ports by tonnage.¹⁰⁵ The northern Gulf also provides diverse fish nursery and feeding grounds in the form of expansive marshes, mangrove stands, swamp forests, and seagrass beds, and boasts some of the best beaches and waters in the United States for recreation and tourism.¹⁰⁶ Coastal tourism and commercial fisheries generate more than \$40 billion of economic activity annually in the five Gulf States.¹⁰⁷ (Figure 6.2)

In 2008, according to NOAA, Gulf commercial fishermen harvested 1.27 billion pounds of finfish and shellfish that earned \$659 million in total landings revenue.¹⁰⁸ Other contributors to the total Gulf fishing economy are seafood processors, warehouses, distributors, and wholesalers. Gulf fishermen land 73 percent of the nation's shrimp—half from Louisiana waters. Louisiana accounts for 67 percent of the nation's oyster production and 26 percent of the blue crab production.¹⁰⁹

As described in Chapter 5, NOAA and state fisheries agencies responded to the *Deepwater Horizon* spill by closing huge portions of the Gulf to commercial and recreational fishing. At the most extensive point, 88,522 square miles of the Gulf of Mexico were closed to fishing¹¹⁰—one-third of the U.S. portion of the Gulf of Mexico, an area larger than the six New England states. In mid-June, NOAA and the Food and Drug Administration (FDA) released a protocol for reopening fisheries that would apply consistently to state and federal waters while striking a balance between keeping tainted seafood from market and unnecessarily crippling the seafood industry.¹¹¹ What ensued was likely the most rigorous seafood-testing campaign in U.S. history.

By late September, when nearly 32,000 square miles of the Gulf were still closed to fishing,¹¹² government officials made strong statements about the safety of seafood caught in reopened areas. "The shrimp, fish, and crabs are perfectly safe to eat," claimed Bob Dickey, Director of Seafood Science and Technology at the FDA.¹¹³ Bill Walker, Executive Director of the Mississippi Department of Marine Resources, pronounced that "based on credible scientific data collected using federally-approved sampling and analytical techniques, Mississippi seafood has been safe and healthy to eat throughout the entirety of this event."¹¹⁴ NOAA Administrator Jane Lubchenco stated, "I have confidence in our protocols and have enjoyed Gulf seafood each trip I've made to the region."¹¹⁵

But despite these assurances, some citizens continue to doubt the safety of Gulf seafood. "Everybody's credibility has been damaged by all this," said Ian MacDonald. He continued, "[The] many changes of course that NOAA took. The great concern about [the Environmental Protection Agency] and the licensing of dispersant use. The fact of the way it was handled has undermined public confidence."¹¹⁶ Florida journalist Travis Pillow asked, "If people couldn't believe [the government's] estimates of how much oil was gushing into the Gulf, how could they believe their reassurance that beaches were clean or seafood was safe?"¹¹⁷

Constant media coverage about the spill also plainly shaped citizens' perception of the risks to public health. According to Timothy Fitzgerald, Senior Policy Analyst for the

Vendor Sign at Taste of Chicago



Perception is reality for the Gulf seafood industry. The economic calamity that descended when commercial fisheries were closed as a health-safety precaution should have been alleviated when they reopened, but the public still wasn't buying. Fact: After a rigorous testing campaign, most commercial species appear untainted.

Albert Ettinger

Environmental Defense Fund's Ocean Program, "Most people have very little connection to, or understanding of, the fish they buy,"¹¹⁸ increasing their reliance on mass media to inform their decisions.¹¹⁹ Scott Dekle, general manager of the VersaCold Atlas seafood warehouse, noted that news of the spill "got plastered all over the local and national media day after day after day. No one sees Anderson Cooper now standing outside Southern Seafood saying, 'This is great.'"¹²⁰ As a result, the public has come to associate Gulf seafood with oil. In August, Jonah Berger, a marketing professor at the University of Pennsylvania's Wharton School, said of Gulf seafood, "[R]ight now, the only association is a negative one, and so it's going to be much harder for that association to disappear."¹²¹

Most commercial Gulf seafood species seem to have emerged from the oil spill without any clear evidence of taint or contamination.¹²² The real impact here is the reputational damage to Gulf seafood as a safe brand. Continued government testing, improvements in public outreach, and a coordinated marketing campaign may be needed to expedite its recovery. After several requests over several months, BP relented in early November and agreed to give Louisiana \$48 million and Florida \$20 million for seafood testing and marketing.¹²³ As of early December, BP is considering a similar request from Alabama.¹²⁴

Voices from the Gulf

“We were called liars when we said we didn’t have oil on the beaches”



Patricia Denny, Destin, FL

On May 2, 1985, Patricia Denny took a job as a secretary in a brand new real estate company in Destin, Florida, a small Emerald Coast family beach town proud of its white beaches and green waters. She married, had two girls, and worked hard at Holiday Isle Properties, rising to General Manager, where she managed 177 vacation rentals. In 2009, her longtime boss retired and Denny became the owner. “I was beyond excited. My dream was coming true—all the late hours, 7-day work weeks. Something I felt so passionate about was finally happening.”

Joe Mayer

In her 24 years as a property manager, Denny has weathered some tough years: “I truly never thought things could be worse than 2004-5. Not only did the real estate market come to an abrupt halt, we had hurricane after hurricane. . . . But we rebounded on our own—no hand-outs, no help from government or our insurance company.”

In late April 2010, when Denny saw the news on TV about the *Deepwater Horizon* explosion, “I remember thinking, ‘How awful,’ but the news reported that BP was going to stop the oil from spewing and all would be well. . . . Then NOAA predicted a shift in the weather and that impact from the oil was imminent. I was devastated. I couldn’t sleep, I couldn’t eat. It was the worst time of my life. Everything was at risk—my home, my income, my children’s education, my three employees who are like a family to me.”

In early May, to show that their pristine beaches were still sugary white, “We started filming daily and sometimes twice daily a video for YouTube called Shore Shots. It involved one of my employees standing in front of the camera and showing the Gulf of Mexico and the lack of oil despite being told otherwise. . . . It was not always well received. We were called liars when we said we didn’t have oil on the beaches and told we were poisoning people with Corexit for our own greedy gain. It was definitely tough.

“By July the oil was here. No way I could prevent it from coming on – revenue dropped significantly. By August it was awful. No one, I mean no one, believed that we weren’t covered in oil similar to the *Exxon Valdez*.”

Denny’s older daughter was a junior and biology major at the University of Alabama in Birmingham. As the cancellations rolled in, the young woman withdrew from college in July for what would have been her senior year. She moved home to help her mother run the company. “It breaks my heart to see her do this,” says Denny. “I am hoping she can go back sometime in the future but at this time I don’t know when that is.”*

*In early December 2010, Denny received compensation for her losses from the Gulf Coast Claims Facility, administered by Kenneth Feinberg and funded by BP.

Public Health Precautions

PUBLIC HEALTH PRECAUTIONS

This beach has been impacted by the oil spill in the Gulf of Mexico.

Oil may come and go at any time and it may not be visible.
If you see oil in the water, you are cautioned not to enter.

- Do not handle tar balls.
- Avoid contact with the oil.
- If you get oil or tar balls on your skin, wash with soap and water.
- If you get oil on your clothing, launder as usual.
- Do not use harsh detergents, solvents or other chemicals to wash oil from skin or clothing; they may promote absorption of the oil through the skin.
- If the odor causes nausea, vomiting, headache or breathing problems, leave the affected area.

FOR MORE INFORMATION CONTACT:

Alabama Department of Public Health	1.866.264.4073
Report oiled wildlife	1.866.557.1401
Report odor	1.800.424.8802

ADVISORIES WILL BE POSTED AS NECESSARY. **ADPH.ORG**
07.30.10

A sign of the times is posted at a public beach in Alabama. Long viewed strictly as environmental disasters, major oil spills can be hazardous to human health, beyond direct fatalities or injuries. Many Gulf Coast residents have complained of respiratory problems and headaches, and depressive illness has skyrocketed.

Coastal tourism. The Gulf coast generates an estimated \$19.7 billion of tourism activity annually.¹²⁵ Florida accounts for more than 50 percent of the total¹²⁶ and, accordingly, attributes enormous actual and potential losses in tourism-related revenue to the oil spill. Quantifying such losses and the value of reputational damage may be even more difficult than assigning a value to the indirect losses suffered by the Louisiana fishing industry. Furthermore, responsibility for compensating those who may have suffered the indirect financial losses poses challenges of law, administration, and equity.

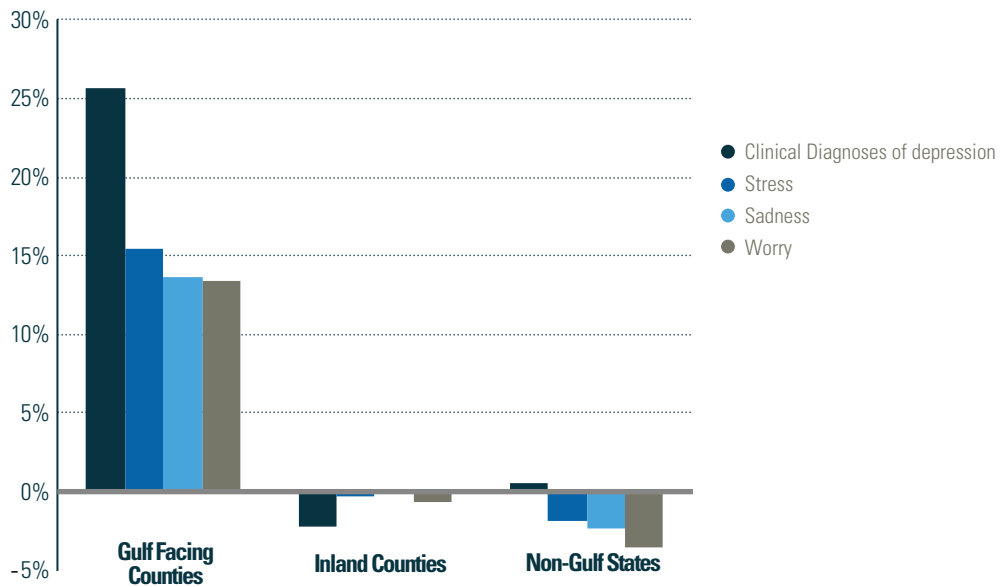
Floridians expressed frustrations with the news coverage of the oil spill—not all of it accurate. As described by Keith Overton, Chairman of the Florida Restaurant and Lodging Association and Chief Operating Officer of the TradeWinds Island Resorts in St. Pete Beach, in testimony before the Commission in July 2010, “These losses have occurred in our area, in the Tampa Bay area, without a single drop of oil ever reaching our beach and that is true for most of Florida. Pensacola has had some oil but the rest of the Panhandle is in pretty good shape right now. But you wouldn’t know that if you looked at the national news media or you read the newspaper each day.”¹²⁷ With dismay, he described a newscast that showed footage of President Obama walking along an unoiled Pensacola beach in mid-June, but with superimposed oil dripping down the screen behind him.

Just as the potential extent of the spill’s impact was coming into focus, Michael Hecht, President of Greater New Orleans, Inc., a regional economic alliance in southeast Louisiana, testified in July that “going forward . . . this perception, this brand issue, is incredibly important.”¹²⁸ A Louisiana-commissioned national poll conducted in early August 2010 found that 29 percent of respondents who were planning to visit the state said they were actively canceling or postponing their visits because of the oil spill.¹²⁹ Overton noted that the downturn in hotel reservations through June 2010 in unoiled Pinellas County had cost roughly \$70 million and could total in the billions for the Florida Panhandle.

Human Health

Because oil spills have historically been viewed as environmental disasters, affecting nature, the Oil Pollution Act of 1990 and related policies offer fewer tools for addressing the human dimensions of such accidents. But in the case of the Macondo blowout—of unprecedented size, affecting a broad area, and the entire regional economy—assessment of impacts must also include the effects on human health, mental and physical. The *Deepwater Horizon* crew of course bore the immediate, devastating effects of the rig’s destruction: 11 deaths, 17 injuries, and the unquestioned trauma of losing colleagues; the terror of the explosions and fires, the harrowing rescue, and the sense of involvement in the wider damages that ensued; and the rigors of the investigations and recovery efforts since.

But the tangible human health effects are more widespread. It was certainly a cruel, added misfortune that the Macondo spill bore down most heavily on southern Louisiana, less than five years after Hurricane Katrina ravaged the Louisiana and Mississippi coast, ruined much of New Orleans, killed hundreds, drove some of the population away permanently (including essential medical professionals), devastated the local economy, and shocked the nation with images of disorder and suffering. An unfortunate lesson of the oil spill is

Figure 6.3: Recent Changes in Emotional Well Being Along the Gulf Coast

This figure depicts the recent changes in emotional well-being along the Gulf coast, as indicated in the Gallup Survey conducted April 21 to August 6, 2010.

Gallup-Heathways Well-Being Index Change Since April 20th 2010

that the nation was not well prepared for the possibility of widespread, adverse effects on human health and mental well-being, especially among a particularly vulnerable citizenry. Gulf communities have long-time residents with strong roots to the region. Of coastal Louisiana residents surveyed after the spill, 60 percent of respondents reported living in their communities their entire lives and another 21 percent had lived there at least 20 years.¹³⁰ This context of regional and cultural ties to their communities exacerbates the worry and stress caused by the oil spill. Nearly 60 percent of respondents reported feeling worried almost constantly during the week prior to being surveyed because of the spill.¹³¹ Louisiana shrimper Donald Johnfroe, Jr., said, “Everything I’m making now is going to pay off debt from this summer. I’m behind on my child-support payments, house payments. I need money.”¹³² Residents are worried about the economy, their way of life, and the stability of their communities. All of these factors play a role in affecting their health.

During the Commission’s first public hearing in New Orleans on July 12–13, representatives of community groups focused on the psychological impacts. “Our people are used to tragedies and pulling themselves up from their bootstraps . . . but no one is saved from depression and fear,” said Sharon Gauthé, Executive Director of Bayou Interfaith Shared Community Organizing. Grace Scire, Gulf coast Regional Director for Boat People SOS, told the Commission about her experiences working with the Vietnamese, Laotian, and Cambodian communities in the Gulf: “People are so dejected—it’s not even the word for that—they’re still recovering from Katrina.”¹³³ Both speakers emphasized the need for additional community mental health services.

Industry and government responders did not adequately anticipate or address the magnitude of potential health impacts. Meanwhile, many citizens were coping with physical ailments (e.g., respiratory problems, headaches) and stress. Though health agencies eventually issued personal protective equipment guidelines for response workers and created a registry of these newly trained personnel, they missed the crucial window for screening their baseline physical health before the workers were directly exposed to oil products.¹³⁴

Although many of the behavioral and psychological effects of the oil spill remain unknown, a Gallup survey of nearly 2,600 residents revealed that medical diagnoses of depressive illness had increased by 25 percent since the rig explosion.¹³⁵ The “well-being index” included in the Gallup study showed that coastal residents reported being stressed, worried, and sad more often than their inland counterparts (Figure 6.3).

There is also an indication that domestic violence increased. Between April and June 2010, the Administration for Children and Families observed a spike in calls to the National Domestic Violence Hotline from Gulf coast states, most notably in Louisiana.¹³⁶ Such broad community impacts suggest the need to monitor and respond to longer-term effects as warranted, and to pay special attention to especially vulnerable populations along the Gulf coast, including children, minority fishing communities, and Indian tribes.

Children and families. Children are particularly vulnerable to disruption in social, familial, and community stability as a result of disaster. A study conducted after Katrina found that children exposed to the hurricane were five times more likely to suffer from serious emotional disturbances than they were before the hurricane.¹³⁷ Although the direct impacts of the oil spill of course cannot be compared to the utter devastation wrought on entire communities by Katrina, some studies have already begun to document the spill’s impact on children and families. A telephone survey of more than 900 coastal Louisiana adults two months after the spill began indicated that 46 percent felt they were unable to take care of their families as well as they would like.¹³⁸ In another survey of more than 1,200 adults living within 10 miles of the coast, parents from Louisiana and Mississippi reported that more than one-third of their children were suffering mental or physical health effects as a result of the oil spill. The most significant health impact was reported among families earning less than \$25,000 annually.¹³⁹

Exactly what proportion of health symptoms is attributable to the oil spill? Meaningful measurement is difficult at best. The preliminary findings of one academic study reported an “exposure differential” between exposed and non-exposed subjects.¹⁴⁰ Adults and children who were directly exposed to oil were, on average, twice as likely to report new physical or mental health issues as those who were not.¹⁴¹

Minority fishing communities. Another sensitive community is the 40,000 Southeast Asian immigrants who live along the Gulf coast (primarily Vietnamese, but also Laotians and Cambodians, many of them refugees from the decades-long wars in that region), one-fifth of who are fishermen.¹⁴² Most of these families suffered direct, grievous harm from the 2005 hurricanes¹⁴³ and now face the spill-related loss of their livelihoods for an

uncertain duration. Many of the fishermen speak little or no English, making their access to the Gulf Coast Claims Facility especially challenging¹⁴⁴ and posing difficulties in finding work outside the fishing industry. As the Commission heard in July, the cultural stigma associated with mental health problems in some of these communities complicates efforts to help those in need.¹⁴⁵

Tribal communities. According to Brenda Robichaux, former principal Chief of the United Houma Nation, tribal communities on the coast are paying “the ultimate price” for both the mismanagement of the Mississippi River Delta over the past half-century (see discussion in Chapter 7) as well as the development of the offshore oil industry.¹⁴⁶ Both activities have contributed to the loss of wetlands and the destruction of barrier islands, which play crucial roles in protecting the tribes from major storms. Just as they began to recover from four hurricanes in three years, many members of Gulf coastal tribal communities for whom fishing is a lifestyle and a livelihood, suffered directly from the oil spill and face a difficult future.

Long-term health effects. The long-term health impacts of oil spills remain largely uncertain, but research conducted in the wake of other disasters provides some insight. A survey conducted one year after *Exxon Valdez* found that cleanup workers classified as being subjected to “high exposure” were 3.6 times as likely to have a generalized anxiety disorder and 2.9 times as likely to have post-traumatic stress disorder as members of an unexposed group.¹⁴⁷ Alaska Natives were particularly prone to effects of chemical exposure and, for cultural reasons, less likely to seek mental health services.¹⁴⁸ Unlike natural disasters, where mental health consequences generally dissipate relatively quickly, technological disasters are known to have chronic impacts on affected individuals and communities—a problem that is worsened as issues of fault and compensation are negotiated or litigated over an extended period.¹⁴⁹ Important symptoms include depression, substance abuse, domestic violence, psychological disorders, and disruption of family structures.¹⁵⁰ Evidence of these effects, as noted, has already appeared in the Gulf coast communities most directly influenced by the oil spill.¹⁵¹

To date, the Gulf Coast Compensation Fund has maintained that it will not pay damages for mental illness caused by the spill. According to its administrator, Kenneth Feinberg: “If you start compensating purely mental anguish without a physical injury—*anxiety, stress—we’ll be getting millions of claims from people watching television. You have to draw the line somewhere.*”¹⁵² The affected Gulf coast states’ health departments (excluding Texas) received \$42 million for mental health from BP, and the Substance Abuse and Mental Health Administration received \$10 million.¹⁵³

Because no biological specimens were taken at the outset of the response, the study of future health effects will be constrained by a lack of baseline data. No biological samples were taken from cleanup workers before or immediately after their exposure to oil. More generally, given the unreliability of surveillance in the days and weeks after the spill, the quality of any baseline data for studies on long-term health effects was compromised. For future emergency response efforts, the government should have enhanced authority to ensure adequate baseline data and surveillance measures.¹⁵⁴ In the meantime, at a

minimum, long-term monitoring of *Deepwater Horizon* responders' health and of community health in the most affected coastal areas is warranted and scientifically important.

However, the focus on long-term research cannot overshadow the need to provide immediate medical assistance to affected communities, which have suffered from limited access to healthcare services.¹⁵⁵ In the years following Hurricane Katrina, many of the damaged healthcare facilities were not rebuilt or replaced, including the major provider of indigent care, Louisiana State University Charity Hospital.¹⁵⁶ This left coastal communities vulnerable and lacking adequate access to care.¹⁵⁷ The greatest damage to Louisiana's health-services infrastructure was in Region One (Orleans, Jefferson, St. Bernard, and Plaquemines Parishes).¹⁵⁸ A year after the storm, New Orleans had been federally designated as a health professional shortage area (HPSA) for primary care, mental healthcare, and dental care. By 2008, 86 percent of Louisiana's parishes were HPSA-designated, with Medicaid and uninsured residents hardest hit.¹⁵⁹ Resources including federal Primary Care Access Stabilization Grants were made available to the state¹⁶⁰ and by August 2010, five years after Katrina, substantial progress had been made in restoring healthcare resources through a redesigned primary-care safety net.¹⁶¹

* * * *

Assessing the environmental, economic, and human health damages from the *Deepwater Horizon* oil spill is, of course, only the threshold challenge. The even larger challenge now facing the Gulf is how to achieve its restoration, notwithstanding years of failed efforts to recover from past destruction.