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The Dangers of Overreacting to the Deepwater Horizon Disaster

By Kenneth P. Green and Steven F. Hayward

On April 20, 2010, the Deepwater Horizon, a mobile, semisubmersible deep-sea oil-drilling rig leased by British Petroleum (BP), was completing a newly drilled well forty-one miles off the Louisiana coastline in the Gulf of Mexico when it exploded and sank, killing eleven oil-rig workers, injuring seventeen, and triggering the largest offshore oil spill in U.S. territory in American history. It will likely be one of the top ten in world history if it is not stopped soon. The spill is clearly an ecological disaster, but overreaction to it could cause more environmental and economic harm than good. It should be viewed in perspective historically and environmentally, and policymakers should wait to make changes until the full effects of the spill can be understood.

New estimates of the amount of oil leaking from Deepwater Horizon have superseded the initial estimate of 5,000 barrels per day; now, according to the Department of the Interior, oil is leaking at a rate of 20,000 to 40,000 barrels per day, though some estimates run as high as 60,000 barrels per day.[1] Using a midpoint range of 30,000 barrels per day, by June 1 about 172,000 tons[2] had leaked from the well under Deepwater Horizon. By comparison, the *Exxon Valdez* spilled 37,000 tons, and the 1969 Santa Barbara platform spill released 12,000 tons. Numerous efforts to stop the spill have failed, and stemming the flow may ultimately require the installation of a relief well (or wells), which may not be completed until August. If the spill continues at its current rate until August 1, it will be the second-largest offshore platform spill in history (excluding spills caused by acts of war), and the spill will have released between 165,000 and 400,000 tons of oil. (For a comprehensive list of major oil spills over the last sixty years, including volume of oil spilled, see appendix.)

While the public is now beginning to understand the magnitude of the spill, the environmental consequences from the spreading oil are still highly uncertain. Gulf currents could spread the oil to the coastlines of Mississippi, Alabama, Florida, Louisiana, and potentially points farther north. Large fisheries are closed already, crippling the Gulf coast's fishing industry and delivering a blow to its tourist industry, although this is just the beginning of the economic damage. Many people are aghast at the prospect of ecological devastation presented by the spill. A variety of news articles and blog posts, including an article

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Key points in this *Outlook*:

- The Deepwater Horizon oil spill is clearly an ecological disaster, but overreaction to the oil spill risks causing more environmental and economic harm than good.
- To be understood properly, the Deepwater Horizon oil spill must be viewed in perspective, particularly compared with other sources of oil in the oceans (from natural seeps and tankers) and the environmental effects of alternative fuels.
- Despite the economic and environmental damage, there is room for hope: oceans are more resilient ecosystems than land.

in *Newsweek*, have asked whether the Deepwater Horizon spill is the "Three Mile Island" moment for the oil industry.[3] Not to be outdone, Carl Pope, former chairman of the Sierra Club, asks if the Deepwater spill is not really "America's Chernobyl," while Melinda Henneberger of Politics Daily says it is our "environmental 9/11."[4]

Apocalyptic pronouncements aside, people should be concerned about the damage Deepwater Horizon will inflict. Evidence suggests that the effects of the Deepwater Horizon spill will be severe and long lasting. A study in *Science* examining the effects of the *Exxon Valdez* oil spill showed ecosystem damages that persisted for fourteen years.[5] The widespread use of chemical dispersants and the large amount of oil apparently suspended below the ocean surface are raising important questions that will take some time to study and answer. At present, the majority of the oil seems to be suspended in mile-long plumes of tiny bubbles in the deeper ocean. Despite the risks of large environmental and economic damages, the policy response to the Deepwater Horizon spill should be cautious: given the scale of everything related to energy, ham-handed interventions in energy markets have the potential to do more harm than good, both economically and environmentally. Environmental issues have everything to do with tradeoffs; there is no such thing as a risk-free world. Furthermore, the magnitude of the energy sector makes it difficult to foresee the consequences of actions taken in haste.

The Obama administration, reacting to environmentalist pressure, has declared a moratorium on new offshore deepwater drilling pending the outcome of an investigation into the causes of the Deepwater Horizon spill. Many environmentalists wish to go much further; the Sierra Club proposes phasing out all offshore exploration and production permanently.

The Gulf Spill in Perspective

In the midst of the fulminating, handwringing, and opportunistic policy promotion that currently dominate media coverage of the Deepwater Horizon incident, the relative risks of offshore oil exploration and production relative to onshore production and other forms of energy are not receiving much attention. The key point omitted from current discussions is this: major spills from offshore drilling rigs are much rarer, and typically account for smaller amounts of spilled oil, than tanker accidents. Yet oil-rig blowouts, far more than tanker spills, typically generate media frenzy—at least when they occur in U.S. waters. On the surface, this is understandable: a tanker spill is bounded by the quantity of oil on board, while an undersea blowout is indeterminate, and indeed some have lasted for months before the leak could be sealed off at the ocean floor. It took Mexico's famously inept Petróleos Mexicanos (Pemex) nearly nine months to stop the Ixtoc I platform spill in 1979—the largest oil spill on record excluding Saddam Hussein's deliberate fouling of the Persian Gulf in 1991—during which time more than 10,000 barrels leaked into the Gulf of Mexico each day. Whatever amount of oil is leaking into the ocean from the Deepwater Horizon well, proximity to shore and the open-ended amount of oil that can be spilled from an offshore oil-drilling incident make such spills generate more existential dread than tanker spills.

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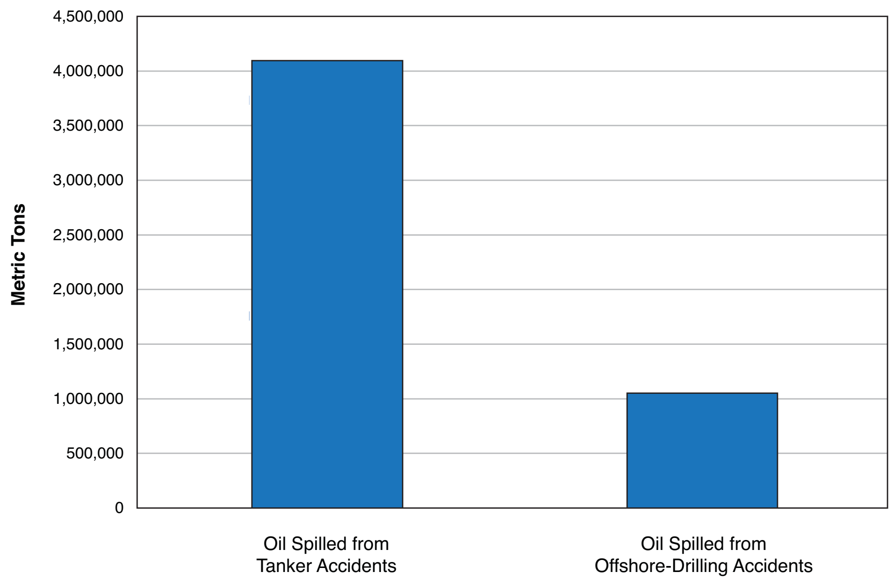
Offshore-rig accidents occur frequently (the British website "Oil Rig Disasters" lists more than 150 offshore-rig mishaps, not all drilling-related, over the last fifty years),[6] but the blowout-prevention technologies that failed on the Deepwater Horizon have kept most offshore oil rigs from releasing more than a trivial amount of oil. Everyone from the U.S. federal government to BP has been criticized for being unprepared to respond to this spill, but how prepared should they have been? The Deepwater Horizon and the Montara platform accident in the Timor Sea last year were the first major offshore-platform blowouts in more than twenty years. The Oil Pollution Control Act of 1990,[7] which prescribed protocols for responding to oil spills, was written in the aftermath of the *Exxon Valdez* spill and with the expectation that tanker spills were the main risk to be managed. From an economic perspective, it is difficult to argue that one has to maintain the infrastructure to prevent or remediate events that can reasonably be expected to happen once in forty years: the costs of maintaining largely idle equipment and trained workers become prohibitive over decades. (The last major U.S. offshore spill was the Santa Barbara spill of 1969.) Even with the high costs of cleaning up a spill after the fact, it can be hard to argue that one would have spent less keeping more clean-up equipment in place over the last forty years. The same situation is true of things like wastewater-treatment plants that experience overflows in particularly heavy storms, running sewage out to sea. Even governments cannot face the economic cost of maintaining the massive surplus capacity that would prevent overflow situations, and they simply plan to warn people away from contaminated waters when overflows happen.

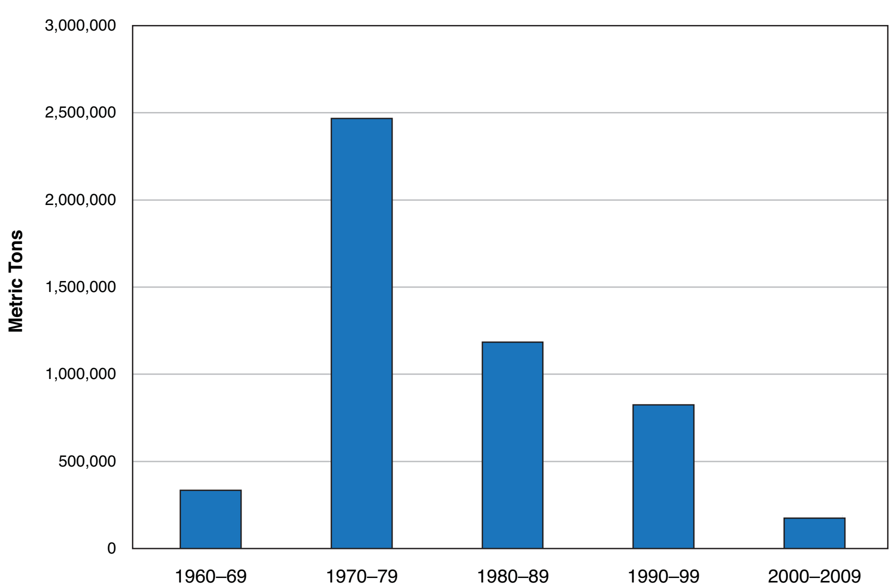
Over the last sixty years, there have been ten offshore-drilling accidents that released more than 5,000 tons of oil into ocean waters. During this same period, there have been seventy-two oil spills from tanker accidents that released 5,000 tons of oil or more—usually a lot more. In other words, for every offshore-drilling accident, there are seven major tanker spills and numerous tanker accidents of smaller size. (Almost unnoticed by the media, a tanker collision in the last week of May near Singapore released about 2,000 tons of oil.)[8] As the appendix shows, most tanker spills are larger in magnitude than offshore-drilling accidents, and in aggregate, they account for more than four times as much oil released into the ocean or coastal waters as offshore-drilling accidents (see figure 1). (Offshore-platform spills are denoted in the appendix by an asterisk.) The *Exxon Valdez*, the most famous tanker-related oil spill in the United States, ranks as the forty-sixth largest tanker spill in the world since the late 1950s (bold in the appendix). The *Exxon Valdez* was not even the largest tanker spill of 1989; the *Khark 5* tanker wreck in Morocco—twenty-second on this list—spilled nearly twice as much oil. Since the *Exxon Valdez* spill, seven larger tanker spills have occurred worldwide.

FIGURE 1
SOURCE OF OIL SPILLS, 1957–2010



SOURCE: Authors' calculations from data in the appendix.

FIGURE 2
WORLDWIDE AMOUNT OF OIL SPILLED FROM TANKERS AND OFFSHORE–DRILLING ACCIDENTS BY DECADE



SOURCE: Authors' calculations from data in the appendix.

Not reflected in the appendix is that when viewed over time, the amount of oil spilled from both tankers and offshore-drilling accidents is down, reflecting changes in shipping (especially double-hulled tankers after the *Exxon Valdez* spill) and offshore-drilling technology (see figure 2). There are about 3,500 offshore rigs active in the Gulf of Mexico and more than 6,500 worldwide. As the National Academy of Sciences (NAS) report brief for the 2003 book *Oil in the Sea III* notes, "Spillage from vessels in North American waters from 1990 to 1999 was less than one-third of the spillage during the prior decade, and, despite increased production, reductions in releases during oil and gas production have been dramatic as well."[9]

The United States produces over 1 million barrels per day from offshore platforms in the Gulf of Mexico—nearly one-quarter of total domestic oil production. If this production is restricted, the United States has three options for replacing the oil that would no longer be produced from the Gulf, each with its own mixture of benefits and drawbacks as well as regulatory and legislative hurdles. One: it can expand onshore production in areas such as the Bakken field in North Dakota or in the currently closed Alaska Natural Wildlife Refuge. Two: the United States can begin developing the oil shale found in western states; these states may hold up to 1 trillion barrels of oil. For this option to be economically viable, however, market prices for oil would need to be consistently higher than they have been in the last few years. Further, this option would involve disrupting the land surface and would require a large amount of water, which is not in abundant supply in western states.[10] Three: the United States can import more oil from overseas, but this option would increase the risk of oil spills from tankers. In 2008, a tanker collision on the Mississippi River in New Orleans released 8,000 tons of oil into the Mississippi Delta; the National Oceanic and Atmospheric Administration has a video of the spill's effects on its website.[11]

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Further, curtailing offshore production in the Gulf may not reduce the ecological risk to the Gulf coast of the United States for two reasons. First, other countries are unlikely to curtail their own offshore exploration in the Gulf. Indeed, Cuba is drilling for oil within one hundred miles of the U.S. shoreline in south Florida, and, as mentioned before, Mexico caused the largest single spill in history in 1979; oil from the Ixtoc I spill reached Texas beaches. (Although oil from the Ixtoc 1 spill reached 125 miles of U.S. coastline in south Texas and killed more than 2,000 birds, Pemex refused to pay damages to the United States, citing sovereign immunity.) Both Venezuela and Brazil are expanding their offshore exploration and production in deep water and are likely to expand to the Gulf of Mexico if the United States scales back.

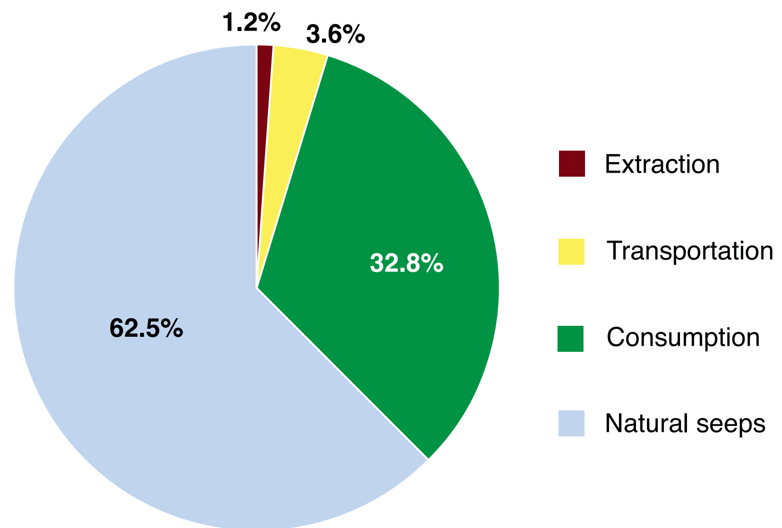
Second, replacing offshore production with alternative energy sources can cause a different kind of environmental harm. While the Deepwater Horizon accident represents an acute short-term shock to Gulf waters and the Gulf coast, the chronic seasonal hypoxic area or "dead zone" in the Gulf (which occurs near the Mississippi Delta where nutrient-rich freshwater from the river leads to decreased oxygen levels in the water) may be aggravated by one policy response that has been suggested in the aftermath of Deepwater Horizon: increased ethanol production. The Nebraska Corn Growers Association seems especially enthusiastic, offering a series of tweets such as "Offshore oil drilling far from fail safe. The spill will boost the appeal of renewable energy, such as ethanol. . . . There is a fuel option that doesn't result in oil spills in the ocean. It's known as ethanol. . . . When was the last time you saw a headline for an ethanol spill in the ocean?"[12] Hypoxia in the Gulf fluctuates from year to year depending on a range of variables, but over the long term, hypoxia has gotten worse. A major contributor to this adverse trend is dissolved inorganic nitrogen (DIN) runoff from the Mississippi River; the amount of DIN in the Gulf will increase with additional ethanol production. A 2008 study published by the NAS observed that "Nitrogen leaching from fertilized corn fields to the Mississippi-Atchafalaya River system is a primary cause of the bottom-water hypoxia that develops on the continental shelf of the northern Gulf of Mexico each summer."[13] The study concluded that current ethanol production goals will increase DIN flowing into the Gulf by as much as 34 percent and could make it impossible to achieve the federal targets for reducing Gulf hypoxia.[14]

Ecosystem Resiliency and Recovery

The amount of oil-based products entering the water each year from offshore production pales in comparison to the amount released through natural seeps or due to human consumption, disposal, and leakage of petroleum products. The NAS 2003 report brief *Oil in the Sea III* notes that "releases from extraction and transportation of petroleum represent less than 10 percent of inputs from human activity. Chronic releases during consumption of petroleum, which include urban runoff, polluted rivers, and discharges from commercial and recreational marine vessels, contribute up to 85 percent of the anthropogenic load to North American waters."[15] (See figure 3.) Some estimate that the amount of oil-based products Americans pour down their household drains exceeds 300 million gallons (or about 1 million tons—much more oil than the Deepwater Horizon's upper spill estimate) each year. The NAS report brief estimates that natural oil seepage into the northern Gulf of Mexico (the area closest to the U.S. coastline) ranged from a low of 4,000 tons per year to as much as 17,000 tons per year; for the entire Gulf of Mexico, the range is estimated to be 80,000 to 200,000 tons per year.[16]

Figure 3

Percentage of Oil in North American Marine Waters by Source



Source: Committee on Oil in the Sea, National Research Council, "Report Brief from *Oil in the Sea III: Inputs, Fates, and Effects"* (Washington, DC: The National Academies Press, 2002), 1, available at http://books.nap.edu/html/oil_in_the_sea/reportbrief.pdf (accessed June 8, 2010).

The NAS report brief notes that "the presence of these seeps, though entirely natural, significantly alters the nature of the local marine ecosystems around them."[17] The effect of oil spills from whatever source on coastal waters and shoreline ecosystems is variable and highly dependent on the type of oil and local conditions. Although, as the NAS report states, "no spill is entirely benign," it adds that "there is no correlation between the size of a release and its impact. Instead, as in the real estate maxim, it's all about 'location, location, location.'"[18] Sometimes small spills have large effects on local wildlife, and large spills can have minor effects. The NAS notes that 30,000 birds were killed in Norway after a small tanker spill in 1981, while the *Amoco Cadiz* spill in 1978—one of the largest tanker spills on record—killed about 5,000 birds. There is a large body of scientific literature on aspects of this subject, but the NAS report notes that large gaps in our knowledge "pose strategic challenges to determining the impact of oil through gathering observational data, as inevitably we make assumptions about the variability in the ecosystem and that variability can obscure large and continuing impacts. . . . The actual impact of the oil may be more complex than we realize if it interacts with spatially or temporally constrained phenomena." *Oil in the Sea* offers the understatement: "These issues are hotly contested after major pollution incidents."[19]

"Assessing recovery after a pollution event is perhaps even more challenging than assessing initial damage," the NAS adds, and this has certainly proven true in the case of the *Exxon Valdez* spill, which, because $180 million of the $900 million civil settlement with Exxon was set aside for scientific follow up, is the most studied oil spill in history.[20] With this volume of research, it is possible to find data supporting a full spectrum of conclusions, from significant lingering harm to full recovery of Prince William Sound. A 2007 study in *Environmental Science and Technology* concluded that a substantial amount of *Exxon Valdez* oil was still present and "will persist for decades up to a century,"[21] while a 2008 study in the *Marine Pollution Bulletin* concluded that "Prince William Sound has reverted to a stable environment of extremely low level contamination in which local perturbations are easily detected."[22] Undoubtedly the environmental effects of the Deepwater Horizon spill will be studied for decades.

Learning from History: The Ixtoc 1 Spill

While waiting for the full ecological impact of the current spill to manifest itself, it is possible to explore historical precedents to set some expectations. The aforementioned Ixtoc 1 spill in the Gulf of Mexico in 1979–80 offers several disquieting parallels to the Deepwater Horizon spill, but also some reasons for guarded optimism. Like Deepwater Horizon, the Ixtoc 1 spill resulted from the failure of a blowout preventer, and subsequent attempts to seal the leak with a cap ("top hat") or by clogging the wellhead ("top kill" and "junk shot") both failed. The leak was not stopped for nine months, at which time two relief wells could be completed. The discouraging aspect of this parallel is that the Ixtoc 1 leak was in only two hundred feet of water, while the Deepwater Horizon is a mile under the ocean. BP has a head start on the relief wells, which are already more than 10,000 feet under the ocean floor. On the other hand, if the Deepwater Horizon spill continues as long as the Ixtoc 1 (nine months), it will easily eclipse Ixtoc 1 as the largest spill in history.

There is considerable risk that overreaction to the Deepwater Horizon spill will have second-order environmental impacts that could be cumulatively worse than the spill itself, both for the Gulf and for other environmental arenas.

The Ixtoc 1 well blew out June 3, 1979, and the leak was not stopped until March 1980. Oil from the spill began washing up on 125 miles of Texas coastline by early August. It is estimated that only 4,000 tons of oil made it to U.S. shores, about 1 percent of the total amount of oil spilled. (About 30,000 tons was estimated to have reached Mexican shorelines.) Both the United States and Mexico deployed confinement booms in an attempt to protect coastlines—with limited effectiveness—and engaged in beach clean-up activities and wildlife triage efforts (such as relocating 10,000 endangered baby Kemp Ridley turtles). As BP has done with the Deepwater Horizon spill, Pemex made heavy use of chemical dispersants.[23] According to a study by the Royal Swedish Academy of Sciences, about half of the oil evaporated, and another 25 percent sank to the bottom of the ocean, much of it broken up by wave action and chemical dispersants. The Swedish Academy study estimated that oil from the Ixtoc 1 poisoned a 15,000 square kilometer area, devastating crab, shrimp, and fish stocks and leading to large oxygen-killing plankton blooms. Overall fish landings fell by up to 70 percent in Mexican and Texas coastal waters, although the 15,000 square kilometer area represented only about 2.5 percent of Mexican Gulf coast waters.[24] Hurricane Frederick struck the Texas coast in September 1979 and washed away 95 percent of the oil that had reached shoreline beaches and marshes.[25] This indicates that, despite current fears, the effects of tropical storms and hurricanes in the midst of the Deepwater Horizon spill could cut in both directions. In November 1979, the damages to the Texas Gulf coast were aggravated when oil tanker *Burmah Agate* collided with another tanker at the entrance to Galveston Bay. The *Burmah Agate* leaked nearly 35,000 tons of oil (nearly as much as the *Exxon Valdez*) and burned for nearly a month.

Conclusion

It will be some time before we have a better idea of the nature and extent of the environmental damage from the Deepwater Horizon spill, but while the severity of the spill should not be downplayed, there are a few reasons for cautious optimism. In general, ocean ecosystems tend to have faster recovery times than either freshwater or land ecosystems because the area available for the dilution and dispersal of spilled oil droplets is so vast, because turbulence in the ocean helps aerate the water, and because it is relatively easy for areas to be repopulated from adjacent areas once the disturbance has stopped. A recent study of seven basic ecosystem types and the disturbances they are most likely to experience found that of ecosystems that make a recovery from various catastrophic events (and, it must be noted, not all do), ocean ecosystems disrupted by oil spills were the fastest to recover, often within a span of one to four years. By contrast, it can take more than forty years for forestlands to recover from deforestation or fire.[26] As the *New York Times* noted in a 1993 story, the Persian Gulf recovered surprisingly faster than anticipated from the 1.2-million-ton spill Saddam Hussein unleashed on the Gulf at the end of the first Gulf War in 1991: "The vast amount of oil that Iraqi occupation forces in Kuwait dumped into the Persian Gulf during the 1991 war did little long-term damage, international researchers say."[27] The Deepwater Horizon spill may not even be the most significant chronic environmental problem for the Mississippi Delta and the Gulf coastline, as one of us noted in the aftermath of Hurricane Katrina five years ago.[28]

Another cause for optimism lies in the type of oil going into the Gulf, which, according to most reports, is light sweet crude oil. As the Alaska Department of Fish and Wildlife observes, light oils are less likely to cause long-term contamination than are either medium or heavy oils.[29]

Still another cause for optimism is the location of the oil. The novel conditions of this spill have created a unique and previously unforeseen situation: rather than mostly rising and moving to shore, most of the oil is remaining dispersed in solution in the ocean. While that oil is bound to cause significant damage to marine life, the damage would likely have been much worse had more of the oil made landfall along Gulf-coast shores. Indeed, it is possible that the conditions of the Deepwater Horizon spill may cause the bulk of the oil to stay in less vulnerable ecosystems, where resilience is highest and recovery is fastest.

The intense media and political attention on the spill is understandable, but just as reaction to the Three Mile Island nuclear accident of 1979 is now regarded as excessive and the cause of increased use of coal for additional energy, there is considerable risk that overreaction to the Deepwater Horizon spill will have second-order environmental impacts that could be cumulatively worse than the spill itself, both for the Gulf and for other environmental arenas. Even if the costs of the spill exceed $12 billion (to be borne by BP) as now seems likely, the benefits of continued offshore oil production still exceed the costs by a wide margin. Economist Peter Passell estimates a net economic benefit of nearly $1 trillion from continued offshore production.[30] This will not be a popular position to hold as long as livestreaming video of the oil spill continues and the media continues to cover the spill in a state of near hysteria. But it is at precisely such times that rational analysis needs to be heard.

It is also understandable that policymakers would want to get ahead of the issue, and, as they are already doing, begin to institute restrictions on drilling, seek to assign blame, hold hearings, instruct agency personnel to reexamine safety regulations and requirements, and so on. But until all the information is in, the best thing the government can do is to assist in containment and remediation, direct scientific resources to study the spill and its consequences, and determine the facts of what led up to the Deepwater Horizon spill, both in the executive offices of BP and in the halls of the Department of the Interior and the Minerals Management Service.

The authors would like to thank AEI research assistant Hiwa Alaghebandian and AEI intern Eliza Gheorghe for their assistance preparing this Outlook.

Notes

1. U.S. Department of the Interior, "Flow Rate Group Provides Preliminary Best Estimate of Oil Flowing from BP Oil Well," news release, May 27, 2010, available at www.doi.gov/news/pressreleases/Flow-Rate-Group-Provides-Preliminary-Best-Estimate-Of-Oil-Flowing-from-BP-Oil-Well.cfm (accessed June 7, 2010).

2. All mentions to tons in this *Outlook* are in reference to metric tons. One metric ton is the equivalent of 7.33 barrels of oil.

3. Matthew Phillips, "A 'Three Mile Island' for Offshore Oil," *Newsweek*, April 30, 2010.

4. Carl Pope, "America's Chernobyl?" Huffington Post, May 3, 2010, available at www.huffingtonpost.com/carl-pope/americas-chernobyl_b_561769.html (accessed June 7, 2010); and Melinda Henneberger, "Is the BP Oil Spill in the Gulf Our Environmental 9/11?" Politics Daily, June 2, 2010, available at www.politicsdaily.com/2010/06/01/is-bp-oil-spill-our-environmental-9-11 (accessed June 7, 2010).

5. Charles H. Peterson et al., "Long-Term Ecosystem Response to the *Exxon Valdez* Oil Spill," *Science* 302, no. 5653 (December 19, 2003): 2082–86.

6. See "Oil Rig Disasters: Offshore Drilling Accidents," available at www.oilrigdisasters.co.uk (accessed June 7, 2010).

7. *Oil Pollution Act of 1990*, Public Law 101-380, *U.S. Statutes at Large* 104 (1990): 848.

8. "Oil Leaks from Tanker Collision off Singapore," BBC News, May 25, 2010, available at http://news.bbc.co.uk/2/hi/world/asia_pacific/10151722.stm (accessed June 7, 2010).

9. Committee on Oil in the Sea, National Research Council, "Report Brief from *Oil in the Sea III: Inputs, Fates, and Effects*" (Washington, DC: The National Academies Press, 2002), 1, available at http://books.nap.edu/html/oil_in_the_sea/reportbrief.pdf (accessed June 8, 2010).

10. A Bureau of Land Management (BLM) report estimates that an oil shale surface mine producing 50,000 barrels of shale oil per day in the western United States would generate surface disturbance of approximately 5,760 acres (roughly 9 square miles). The BLM report estimates that an underground mine producing 50,000 barrels of shale oil per day in the western United States would generate surface disturbance of approximately 1,650 acres (roughly 2.5 square miles). The Department of Energy (DOE) estimates the water usage for new retorting methods to be about one to three barrels of water per barrel of shale oil produced. The BLM report estimates water usage for surface mines and underground mines to be 2.6–4 barrels of water per barrel of oil; in-situ processes would require 1–3 barrels of water per barrel of shale oil produced. The BLM report

found that two to ten gallons of wastewater are produced for each ton of shale oil produced. See BLM, *Draft Oil Shale and Tar Sands Resource Management Plan Amendments to Address Land Use Allocations in Colorado, Utah, and Wyoming and Programmatic Environmental Impact Statement*, vol. 2 (Washington, DC: U.S. Department of the Interior, December 2007), available at http://ostseis.anl.gov/documents/dpeis/volumes/OSTS_DPEIS_Vol_2.pdf (accessed June 10, 2010); and DOE Office of Petroleum Reserves–Strategic Unconventional Fuels, "Fact Sheet: Oil Shale Water Resources," n.d., available at http://fossil.energy.gov/programs/reserves/npr/Oil_Shale_Water_Requirements.pdf (accessed June 10, 2010).

11. The video is available through the National Oceanic and Atmospheric Administration (NOAA) Office of Response and Restoration, "New Orleans Spill Incident: Barge DM932," July 23, 2008, available at http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY(entry_subtopic_topic)=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=749&subtopic_id(entry_subtopic_topic)=2&topic_id(entry_subtopic_topic)=1 (accessed June 8, 2010).

12. Dan Mitchell, "Ethanol Fans Milk Slick Catastrophe," The Big Money's Daily Bread: The Business of Food, April 29, 2010, available at www.thebigmoney.com/blogs/daily-bread/2010/04/29/corn-lobbyists-latch-tragic-oil-spill?page=ful (accessed June 8, 2010); and Nebraska Corn Growers Association, NeCGA Twitter, available at http://twitter.com/NeCGA (accessed June 8, 2010).

13. Simon D. Donner and Christopher J. Kucharik, "Corn-Based Ethanol Production Compromises Goal of Reducing Nitrogen Export by the Mississippi River," *Proceedings of the National Academy of Sciences of the United States of America* 105, no. 11 (March 18, 2010): 4513.

14. Ibid.

15. Committee on Oil in the Sea, National Research Council, "Report Brief from *Oil in the Sea III: Inputs, Fates, and Effects*."

16. NOAA's Office of Response and Restoration notes: "Apart from oil spills caused by human actions, oil also is released into the environment from natural oil seeps in the ocean bottom. One of the best-known areas where this happens is Coal Oil Point along the California coast near Santa Barbara. An estimated 2,000–3,000 gallons of crude oil is released naturally from the ocean bottom every day just a few miles offshore from this beach. . . . In the early 1500s, the Portuguese-born explorer Juan Cabrillo sailed into what is now Santa Barbara, California, and remarked on the oil he saw bubbling out from a natural seep. He reported that the Chumash Indians scooped and skimmed up the oil, which they used to waterproof their boats." See NOAA Office of Response and Restoration, "Oil Spills in History," in "Frequently Asked Questions, Oil and Chemical Spills," available at http://response.restoration.noaa.gov/faq_topic.php?faq_topic_id=1#2 (accessed June 8, 2010).

17. Committee on Oil in the Sea, National Research Council, "Report Brief from *Oil in the Sea III: Inputs, Fates, and Effects*."

18. Ibid.

19. Ibid.

20. Writing for *Science*, Lila Guterman says, "The *Valdez* studies are the largest, longest, and most expensive ever done." See Lila Guterman, "Conservation Biology: *Exxon Valdez* Turns 20," *Science* 323, no. 5921 (March 20, 2009): 1558.

21. Jeffrey W. Short et al., "Slightly Weathered *Exxon Valdez* Oil Persists in Gulf of Alaska Beach Sediments after 16 Years," *Environmental Science and Technology* 41, no. 4 (2007): 1245–50, quoted in Ibid.

22. James R. Payne, William B. Driskell, Jeffrey W. Short, and Marie L. Larsen, "Long Term Monitoring for Oil in the *Exxon Valdez* Spill Region," *Marine Pollution Bulletin* 56, no. 12 (2008): 2067.

23. For a good explanation of how oil dispersants work, see Katie Peek, "How Do Oil Dispersants Work?" Popular Science Online, May 28, 2010, available at www.popsci.com/science/article/2010-05/how-do-oil-dispersants-work (accessed June 8, 2010).

24. Arne Jernelöv and Olof Lindén, "Ixtoc I: A Case Study of the World's Largest Oil Spill," *Ambio* 10, no. 6 (1981): 299–306.

25. Carlos E. Restrepo et al., "Ixtoc 1 Oil Spill Economic Impact Study," report prepared for the Bureau of Land Management, Department of the Interior, 1982, 6.

26. Holly P. Jones and Oswald J. Schmitz, "Rapid Recovery of Damaged Ecosystems," Plos One 4, no. 5 (May 2009): e:5653, available at www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0005653 (accessed June 8, 2010).

27. "Gulf Found to Recover from War's Oil Spill," *New York Times,* March 18, 1993.

28. See Steven F. Hayward, "Katrina and the Environment," AEI *Environmental Policy Outlook* (September–October 2005), available at www.aei.org/outlook/23244.

29. U.S. Fish and Wildlife Services, "Effects of Oil Spills on Wildlife and Habitat," December 2004, available at http://alaska.fws.gov/media/unalaska/Oil%20Spill%20Fact%20Sheet.pdf (accessed June 11, 2010).

30. See Ronald Bailey, "Weighing the Benefits and Costs of Offshore Drilling," Reason.com, May 4, 2010, available at http://reason.com/archives/2010/05/04/weighing-the-benefits-costs-of (accessed June 8, 2010).

APPENDIX

MAJOR OIL SPILLS OF THE LAST SIXTY YEARS

Spill	Location	Size (Metric Tons)	Year
Gulf War	Persian Gulf	1,200,000	1991
Ixtoc I*	Mexico	460,000	1979
Deepwater Horizon* [High-end est.]	United States	400,000	2010
Deepwater Horizon* [Mid-point est.]	United States	300,000	2010
Atlantic Empress	Trinidad	287,000	1979
Nowruz Field Platform*†	Persian Gulf	260,000	1983
ABT Summer	Angola	260,000	1991
Castillo de Bellver	South Africa	252,000	1983
Amoco Cadiz	France	225,000	1978
Deepwater Horizon*[Low-end est.]	United States	165,500	2010
Odyssey	Canada	132,000	1988
Sea Star	Oman	115,000	1972
Morris Berman	Puerto Rico	109,000	1994
Texaco Denmark	Belgium	102,000	1971
Torrey Canyon	United Kingdom	100,000	1967
Urquiola	Spain	100,000	1976
Irenes Serenade	Greece	100,000	1980
Hawaiian Patriot	United States	95,000	1977
MD Independenta	Turkey	95,000	1979
Julius Schindler	Azores	92,000	1969
Jakob Maersk	Portugal	88,000	1975
Braer	United Kingdom	85,000	1993
Ekofisk*	North Sea	81,000	1977
Kkark 5	Morocco	75,000	1989
Aegean Sea	Spain	74,000	1992
Katina P	Mozambique	72,000	1992
Nova	Iran	70,000	1985
Sea Empress	United Kingdom	70,000	1996
Betelgeuse	Ireland	64,000	1979
Prestige	Spain	63,000	2002
Epic Coloctronis	Puerto Rico	59,000	1975
Sinclair Petrolore	Brazil	57,000	1960
Othello	Sweden	55,000	1970
Metula	Chile	54,000	1974
Yuko Maru	Japan	51,000	1974
Assimi	Oman	51,000	1983
Andros Patria	Spain	47,000	1978
World Glory	India	46,000	1968
British Ambassador	Japan	46,000	1975
Ennerdale	Indian Ocean	45,000	1970
Pericles	Qatar	45,000	1983
Tadotsu	Indonesia	43,000	1978
Mandoil II	United States	41,000	1968
Wafra	South Africa	40,000	1971
Juan Lavalleja	Algeria	40,000	1980
Napier	Chile	38,000	1973
Trader	Greece	37,000	1972
Exxon Valdez	United States	37,000	1989

NOTE: * denotes offshore-platform spills; † denotes Nowruz platform spill, an act of war, not an equipment accident.

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Spill	Location	Size (Metric Tons)	Year
Thanassis A	China	37,000	1994
Corinthos	United States	35,700	1975
Burmah Agate	United States	34,700	1979
St. Peter	Colombia	34,000	1976
Abkatun 91*	Mexico	33,700	1986
Athenian Venture	Canada	33,000	1988
Irene's Challenge	Pacific Ocean	32,400	1977
Venoil	South Africa	29,800	1977
Borag	Taiwan	29,000	1977
Funiwa No. 5*	Nigeria	27,000	1980
Argo Merchant	United States	26,000	1976
Jiyeh Power Station	Lebanon	25,000	2006
African Queen	United States	21,000	1958
Erika	France	20,000	1999
MT Haven	Italy	19,500	1991
Nakhoda	Japan	19,000	1997
Montara Oil Platform*	Timor Sea	18,000	2009
Kirki	Australia	17,280	1991
Mega Borg	Mexico	16,500	1990
Seki	United Arab Emirates	15,900	1994
Tarik Ibn Ziyad	Brazil	15,000	1975
Tasman Spirit	Pakistan	15,000	2006
Tanio	France	13,500	1980
Hasbah 6*	Saudi Arabia	13,500	1980
Limburg	Persian Gulf	12,200	2002
Santa Barbara Channel*	United States	12,000	1969
Nagasaki Spirit	Malacca Strait	12,000	1992
Korea	Korea	10,800	2007
Alvenus	United States	8,800	1984
New Orleans	United States	8,800	2008
Shell Platform 26*	United States	8,000	1970
YUM II/Zapoteca*	Mexico	8,000	1987
Sea Spirit	Gibraltar	6,600	1990
Citgo Refinery	United States	6,500	2006
Mobil Nigeria	Nigeria	5,500	1998
Zoe Coloctronis	Puerto Rico	5,100	1973
Trinimar Marine 327*	Venezuela	5,000	1973
Statfjord	Norway	4,000	2007

SOURCES: Authors' compilation from the following: "List of Oil Spills," Wikipedia, available at http://en.wikipedia.org/wiki/List_of_oil_spills (accessed June 8, 2010), this list is incomplete and inaccurate but contains many useful references; International Tanker Owners Pollution Federation, "Statistics," 2010, available at www.itopf.com/information%2Dservices/data%2Dand%2Dstatistics/statistics (accessed June 8, 2010); Dagmar Schmidt Etkin and Jeff Welch, "International Oil Spill Database: Trends in Oil Spill Volumes and Frequency" (*Oil Spill Intelligence Report*, International Oil Spill Conference, Arlington, MA, 1997), available at www.iosc.org/papers/01480.pdf (accessed June 8, 2010); National Oceanic and Atmospheric Administration (NOAA) Hazard Materials Response and Assessment Division, *Oil Spill Case Histories, 1967–1991: Summaries of Significant U.S. and International Spills* (Seattle, WA: NOAA, September 1992), available at http://response.restoration.noaa.gov/book_shelf/26_spilldb.pdf (accessed June 8, 2010); "Oil Rig Disasters: Offshore Drilling Accidents," available at www.oil-rigdisasters.co.uk (accessed June 7, 2010); and Will Wright, "The Worst Major Oil Spills in History: By Comparison to These, the *Exxon Valdez* Was a Minor Spill," Associated Content Inc., November 25, 2007, available at www.associatedcontent.com/article/454782/the_worst_major_oil_spills_in_history.html?cat=37 (accessed June 8, 2010).

NOTE: * denotes offshore-platform spills; † denotes Nowruz platform spill, an act of war, not an equipment accident.