BYU Law Review

Volume 2011 | Issue 6 Article 3

12-18-2011

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Recommended Citation

Robin Kundis Craig, *Legal Remedies for Deep Marine Oil Spills and Long-Term Ecological Resilience: A Match Made in Hell*, 2011 BYU L. Rev. 1863 (2011).
Available at: https://digitalcommons.law.byu.edu/lawreview/vol2011/iss6/3

Legal Remedies for Deep Marine Oil Spills and Long-Term Ecological Resilience: A Match Made in Hell

Robin Kundis Craig*

ABSTRACT

The Deepwater Horizon *oil spill that lasted from April to September 2010 was not only the worst oil spill disaster in United States history, but also the first to occur at great depth. Drilling at great depth multiplies the risks and complications of offshore oil extraction. It also, as this Article explores, makes natural resource damages a decisively inadequate remedy for the injuries done to the Gulf of Mexico's (the "Gulf") ecosystems, especially the poorly understood but highly productive ecosystems that exist almost a mile below the surface. This Article argues that our current natural resource damages regimes for oil spills depend too heavily on an assumption that ocean areas like the Gulf are stably resilient, able to absorb and recover from an incessant series of environmental insults ranging from widespread loss of wetlands to nutrient pollution and a dead zone to overfishing to continual releases of oil. By acknowledging that disasters like the* Deepwater Horizon *oil spill could push ecosystems across regime-shifting thresholds into new states, resilience thinking better captures the inherent and unavoidable risks that exploitative activities in the Gulf actually pose to the socio-ecological systems that depend on its continued productive functioning. As a result, resilience thinking can also suggest new and more comprehensive ways of thinking about oil spill liability that might bring about the reformations in offshore oil drilling regulation that many commentators seek.*

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I. INTRODUCTION

The *Deepwater Horizon* oil rig was huge, weighing in at 33,000 tons and supporting four decks of working space and an oil derrick that rose another twenty stories above the platform.[1] It cost $350 million to build[2] and had arrived at the Macondo lease site on January 31, 2010, to drill the Macondo well for British Petroleum ("BP").[3]

Less than three months later, "BP and the Macondo well were almost six weeks behind schedule and more than $58 million over budget."[4] The commercial pressures BP faced as a result of these cost overruns likely led it to take shortcuts, and these shortcuts probably help to explain why, on the night of April 20, 2010, the Macondo well blew out. The well's explosion engulfed the *Deepwater Horizon* in flames, requiring abandonment of the rig,[5] and killed eleven crew members.[6] The rig itself sank into the depths of the Gulf of Mexico (the "Gulf") two days later, on April 22—Earth Day.[7]

In the aftermath of this human tragedy, concerns about the environment began to grow. Immediate attempts to trigger the rig's "blowout preventer" failed,[8] and "[b]y mid-afternoon on April 23, [remotely operated] vehicles discovered that oil was leaking from the end of the riser, where it had broken off from the *Deepwater Horizon* when the rig sank."[9] A second leak was discovered the next day, leading to the Unified Command's announcement "that the riser was leaking oil at a rate of 1000 barrels per day."[10] The background of this estimate remains unclear, although the estimate itself appears to have come from BP.[11] A few days later, a National Oceanic and Atmospheric Administration ("NOAA") scientist estimated that the

1. *See* NAT'L COMM'N ON THE BP *DEEPWATER HORIZON* OIL SPILL AND OFFSHORE DRILLING, DEEP WATER: THE GULF OIL DISASTER AND THE FUTURE OF OFFSHORE DRILLING: REPORT TO THE PRESIDENT 1 (2011) [hereinafter 2011 BP DISASTER REPORT], *available at* http://tinyurl.com/4j5fy8k.

2. *See id.* at 2.

3. *See id.* at 3.

4. *Id.* at 2.

5. *See id.* at 6–19.

6. *See id.* at 55.

7. *See id.*

8. *Id.* at 131.

9. *Id.* at 132.

10. *Id.*

11. *See id.*

well was releasing about 5000 barrels of oil a day, although, given the uncertainties involved in the estimation because of the depth of the leak, he also noted that the flow could have been as much as 10,000 barrels per day.[12]

Immediate environmental consequences included surface oil slicks, fishery closures,[13] contaminated beaches,[14] oiled wildlife,[15] and increasing reports of health problems among spill workers.[16] Oil spill responders sprayed dispersants on the surface oil for twelve weeks,[17] releasing far more of these toxic chemicals into the environment than had been used (even then, controversially) after the 1989 *Exxon Valdez* oil spill in Prince William Sound, Alaska.[18] In response to that 1989 oil spill, responders sprayed a total of about 5500 gallons of dispersant, compared to 141,358 gallons sprayed on the Gulf spill during the week of April 27 to May 3, and another 168,988 gallons the following week.[19] Nevertheless, as was true in Alaska, use of dispersants in the Gulf was controversial. Although the dispersants could reduce coastal and terrestrial impacts, "[l]ess oil on the surface means more in the water column, spread over a wider area, potentially increasing exposure for marine life."[20] The dispersants may even have inhibited the natural biodegradation of oil.[21]

After several unsuccessful attempts to stop the oil leaks, BP finally succeeded on July 15, 2010, after eighty-seven days of oil flowing into the Gulf.[22] "Static kill" procedures[23] in early August helped to finalize the end of the oil spill,[24] and BP permanently

12. *See id.* at 133.

13. *See id.* at 139–43.

14. *See Oil Reaches Louisiana Shores*, THE BIG PICTURE (May 24, 2010), http://www.boston.com/bigpicture/2010/05/oil_reaches_louisiana_shores.html.

15. *See id.*

16. *See OSHA's Efforts to Protect Workers*, OCCUPATIONAL SAFETY AND HEALTH ADMIN., http://www.osha.gov/oilspills/index.html (last visited Sept. 26, 2011).

17. *See* 2011 BP DISASTER REPORT, *supra* note 1, at 143.

18. *See id.* at 144.

19. *See id.*

20. *Id.* at 143.

21. *See id.*

22. *See id.* at 165.

23. The "static kill" procedures involved pumping heavy mud and cement through the blowout preventer and into the well to "suffocate" the flow of oil. Adam Gabbatt, *BP Oil Spill—The Static Kill Explained*, THE GUARDIAN (Aug. 3, 2010, 8:49 AM), http://tinyurl.com/7bogsag.

24. *See* 2011 BP DISASTER REPORT, *supra* note 1, at 167.

sealed the Macondo well in September.[25] Admiral Thad Allen, head of the Unified Command, pronounced the well dead on September 19, almost exactly five months (152 days) after the blowout occurred.[26]

According to the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling ("Deepwater Horizon Commission"), "[t]he *Deepwater Horizon* blowout produced the largest accidental marine oil spill in U.S. history"[27] and "immediately threatened a rich, productive marine ecosystem."[28] On August 4, 2010, the federal government estimated that about 4.9 million barrels of oil total had been released into the Gulf, at a rate ranging from 62,000 barrels per day in April to 52,700 barrels per day in mid-July—a vast increase from the initial estimates.[29] While the government's announcement was widely interpreted as concluding that 75% of the oil was "gone" from the environment (burned, skimmed, directly recovered from the wellhead, or evaporated or dissolved),[30] NOAA Administrator Jane Lubchenco quickly clarified that only about 50% of the oil was "gone"; the rest was considered to be degrading naturally.[31]

Uncertainties regarding the environmental impacts of the Gulf oil spill are many. As the Deepwater Horizon Commission noted, "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."[32] The timing of the oil spill disrupted the reproductive cycles of many species, including the oysters that the Gulf is famous for. Oysters are a keystone species in the Gulf—that is, "an organism that exerts a shaping, disproportionate influence on its habitat and community."[33] The spill probably impacted bluefin tuna as well. The Gulf is considered part of the bluefin's "essential fish habitat,"[34] and

25. *See id.* at 169.
26. *See id.*
27. *Id.* at 173.
28. *Id.* at 174.
29. *See id.* at 167.
30. *See id.* at 167–68.
31. *See id.* at 168 & fig. 5-2.
32. *Id.* at 174.
33. *Id.* at 178.
34. *Id.*; *see also* Robin Kundis Craig, *The Gulf Oil Spill and National Marine Sanctuaries*, 40 ENVTL. L. REP. NEWS & ANALYSIS 11074, 11074 (2010) (noting that injuries

"the Ocean Foundation estimated that the spill could have affected 20% of the 2010 season's population of bluefin tuna larvae, further placing at risk an already severely overfished species."[35] Endangered species of whales and sea turtles were also impacted by the oil spill: wildlife responders collected 1144 sea turtles and 109 marine mammals that had been injured by the spill, and many more undiscovered injuries of the same types are suspected to have occurred.[36]

However, what makes the *Deepwater Horizon* oil spill "special" in terms of how we think about environmental risk and environmental damage in the United States—and, more broadly, in terms of how we think about offshore oil drilling—is the great depth at which the spill occurred. Unlike previous oil spills in the Gulf, "this one spewed from the depths of the ocean, the bathypelagic zone (3300–13,000 feet deep)."[37] Importantly, this area, although deep and dark, is not a Gulf "dead zone"; instead, the Gulf's bathypelagic zone has "abundant and diverse marine life," including cold-water corals, light-producing fish, sperm whales, and giant squid.[38] However, the additional risks to the Gulf's species and ecosystems from such deepwater drilling were not—as many commentators have made clear—properly considered or regulated.[39]

to the bluefin tuna could have impacts as far away as the Mediterranean Sea).

35. 2011 BP DISASTER REPORT, *supra* note 1, at 181.

36. *See id.*

37. *Id.* at 174.

38. *Id.*

39. *See, e.g.*, Richard Oliver Brooks, *The Gulf Oil Spill: The Road Not Taken*, 74 ALB. L. REV. 489, 497–507 (2010–2011); Miriam A. Cherry & Judd F. Sneirson, *Beyond Profit: Rethinking Corporate Social Responsibility and Greenwashing After the BP Oil Disaster*, 85 TUL. L. REV. 983, 988–99 (2011); Alyson C. Flournoy, *Three Meta-Lessons Government and Industry Should Learn from the BP* Deepwater Horizon *Disaster and Why They Will Not*, 38 B. C. ENVTL. AFF. L. REV. 281, 289–302 (2011); Andrew Hartsig, *Shortcomings and Solutions: Reforming the Outer Continental Shelf Oil and Gas Framework in the Wake of the* Deepwater Horizon *Disaster*, 16 OCEAN & COASTAL L.J. 269, 299–325 (2011); Peter Jan Honigsberg, *Conflict of Interest that Led to the Gulf Oil Disaster*, 41 ENVTL. L. REP. NEWS & ANALYSIS 10414, 10414–17 (2011); Zygmunt J.B. Plater, *Learning from Disasters: Twenty-One Years After the* Exxon Valdez *Oil Spill, Will Reactions to the* Deepwater Horizon *Blowout Finally Address the Systemic Flaws Revealed in Alaska?*, 40 ENVTL. L. REP. NEWS & ANALYSIS 11041, 11042–46 (2010); Jonathan Simon & Jennifer Owen, *The Policy and Regulatory Response to* Deepwater Horizon*: Transforming Offshore Oil & Gas Leasing?*, 40 ENVTL. L. REP. NEWS & ANALYSIS 11084, 11084–87 (2010); David M. Uhlmann, *After the Spill Is Gone: The Gulf of Mexico, Environmental Crime, and the Criminal Law*, 109 MICH. L. REV. 1413, 1425–28 (2011).

Moreover, it is not clear that ecological remedies available under existing law will ever fully capture the damage done in the BP Gulf oil spill, let alone be able to restore the affected areas of the Gulf to pre-*Deepwater Horizon* status.[40] The primary remedies available for this damage are natural resource damages under the federal Clean Water Act ("CWA")[41] and the federal Oil Pollution Act of 1990 ("OPA").[42] The federal government and the Gulf states (Texas, Louisiana, Mississippi, Alabama, and Florida) are currently pursuing natural resource damages for the BP oil spill,[43] but much remains uncertain about what damages they can claim.

In particular, proper assessment of natural resource damages requires the ability to compare a baseline condition for a species, habitat, or ecosystem to the postdisaster state.[44] With respect to the *Deepwater Horizon* oil spill, however, baseline conditions for the deepwater areas that the spill affected are largely unknown.[45] In addition, the primary goal of natural resource damages is to restore the affected areas to their predisaster state.[46] This goal may be unattainable in the aftermath of the *Deepwater Horizon* spill because of the many other stresses afflicting the Gulf,[47] particularly given that the Gulf's resilience to such disasters is itself deeply contested. As the Deepwater Horizon Commission noted, restoration in the Gulf must have a different and "broader" meaning than "restoration" under the CWA and OPA, a meaning that "encompass[es] reversing the progressive erosion of coastal land and habitats that buffer human communities from storms and sustain the area's biological productivity."[48]

40. Of course, as other writers have discussed, these are not the only limitations in the Oil Pollution Act of 1990's remedy scheme. *See*, *e.g.*, Keith J. Jones, *Drill Baby . . . Spill Baby: How the Oil Pollution Act's Economic-Damage Liability Cap Contributed to the* Deepwater Horizon *Disaster*, 40 ENVTL. L. REP. NEWS & ANALYSIS 11132, 11134–35 (2010); Ronen Perry, *The* Deepwater Horizon *Oil Spill and the Limits of Civil Liability*, 86 WASH. L. REV. 1, 62–66 (2011).

41. *See* 33 U.S.C. § 1321 (2006).

42. *See id.* §§ 2701–62.

43. 2011 BP DISASTER REPORT, *supra* note 1, at 183.

44. *See id.* at 183–84.

45. *See id.* at 182.

46. *See* discussion *infra* Part III.

47. *See* 2011 BP DISASTER REPORT, *supra* note 1, at 197–213, especially 212–13 (detailing the many problems in the Gulf of Mexico and suggesting that it may not be possible to meet the OPA's definition of "restoration").

48. *Id.* at 212.

This Article argues that the current legal remedy of natural resource damages is likely to be a poor remedy for the *Deepwater Horizon* spill—the "match made in Hell" referenced in this Article's title. While this Article is not the first to make this argument,[49] it focuses specifically on the deepwater context of the *Deepwater Horizon* disaster and the presumption in natural resource damages law that we will be able to both identify and measure the damages that offshore oil spills inflict on marine ecosystems. This presumption flies in the face of the fact that inadequate knowledge about marine ecosystems plagues our marine environmental law and policy.[50] As a result, requiring such knowledge in natural resource damage assessments dooms that damages remedy to inadequacy, especially in nonpristine environments like the Gulf.

Nevertheless, the *Deepwater Horizon* disaster has already inspired, and hopefully will continue to inspire, legal and policy reforms of several types. Given the United States' apparent desire to pursue deepwater offshore oil development despite the dearth of information about most deepwater marine ecosystems, this Article encourages the incorporation of resilience thinking into the law, policy, and ethics of deepwater drilling, especially in the already severely stressed Gulf of Mexico. As Part IV explores in more detail, resilience thinking acknowledges that ecosystems are dynamic—and capable of crossing thresholds from one state to another, often with consequences that humans consider undesirable. As prelude to that discussion, however, Part II of this Article examines in greater detail the depth of the *Deepwater Horizon* oil spill, the different risks that

49. *See*, *e.g.*, Keith H. Hirokawa, *Disasters and Ecosystem Services Deprivation: From Cuyahoga to the* Deepwater Horizon, 74 ALB. L. REV. 543, 553 (2010–2011) (arguing that the full environmental effects of the BP oil disaster are likely to be unknown); Itzchak E. Kornfeld, *Of Dead Pelicans, Turtles, and Marshes: Natural Resources Damages in the Wake of the BP* Deepwater Horizon *Spill*, 38 B.C. ENVTL. AFF. L. REV. 317, 331–38 (2011) (arguing that natural resource damages should be valued on an ecosystem basis, rather than on a damaged-resource-by-damaged-resource basis).

50. *See* COLIN WOODWARD, OCEAN'S END: TRAVELS THROUGH ENDANGERED SEAS 30 (2000) ("We are better informed about the Moon and Mars than about the bottom of the ocean floor; we know more about the life cycle of stars than those of the sperm whale, giant squid, and many of the creatures sought by the world's fishing fleets."); Robin Kundis Craig, *Avoiding Jellyfish Seas, or, What Do We Mean by "Sustainable Oceans," Anyway?*, 31 UTAH ENVTL. L. REV. 17, 20 (2011) (citing MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: CURRENT STATE AND TRENDS 480, 488 (Rashid Hassan et al. eds., 2005)); Robin Kundis Craig, *Regulation of U.S. Marine Resources: An Overview of the Current Complexity*, 19 NAT. RESOURCES & ENV'T. 3, 3 (2004).

depth imposed compared to shallower water oil spills, and the evolving record of damage to life and ecosystems near the bottom of the Gulf of Mexico. Part III, in turn, first provides an overview of the natural resource damages regimes in the CWA and OPA, then discusses the United States government's December 2010 civil complaint for natural resource damages resulting from the *Deepwater Horizon* oil spill, and concludes by addressing the lack of needed information for making comprehensive natural resource damages claims. Part IV then considers the possible improvements that resilience thinking offers to law, policy, and corporate ethics to get around this "match made in Hell" by encouraging a view of the Gulf—and other areas of the ocean—as as ever-changing sites that respond to internal and external pressures in complex and not-entirely-predictable ways.

II. DEPTH, OIL SPILL DAMAGE, AND THE LONG-TERM PROGNOSIS FOR THE GULF OF MEXICO'S DEEPWATER ECOSYSTEMS

Offshore oil drilling is nothing new in the Gulf of Mexico; the first rig was constructed in 1947.[51] Nevertheless, it bears repeating that the *Deepwater Horizon* oil spill occurred at great depth; it was the first oil spill of its kind in the United States and, indeed, "it happened in deeper water than any other major oil spill in history."[52] The rig was operating in waters that were about 4130 feet (1400 meters) deep.[53]

While Shell built the first deepwater (defined as drilling in waters deeper than 1000 feet[54]) oil platform in the Gulf in 1985,[55] deepwater wells remained uncommon in the Gulf until after the current legal regimes for environmental damages were already in place. For example, the Deepwater Horizon Commission noted that in 1990—as Congress was drafting the OPA—"most oil and gas from the Gulf had still come from shallow water; average production-weighted depth ha[d] barely reached 250 feet."[56] Under

51. *See* NICK HUNTER, OFFSHORE OIL DRILLING 8 (Adam Miller et al. eds., 2012).

52. Mark Schrope, *Deep Wounds*, 472 NATURE 152, 152 (2011).

53. *See* Deepwater Horizon *Drills World's Deepest Oil & Gas Well*, TRANSOCEAN, http://www.deepwater.com/fw/main/IDeepwater-Horizon-i-Drills-Worlds-Deepest-Oil-and-Gas-Well-419C151.html (last visited Sept. 26, 2011).

54. *See* HUNTER, *supra* note 51, at 9.

55. *See id.* at 8.

56. 2011 BP DISASTER REPORT, *supra* note 1, at 41.

the American Academy of Underwater Sciences' recommendations, technical divers using "normal" scuba gear and compressed air can dive to up to 190 feet,[57] while technical divers using mixed gas systems can dive to greater than 260 feet.[58]

In other words, U.S. laws governing liability for offshore oil spills were drafted when offshore oil and gas drilling still operated almost entirely at a human scale—when a viable solution to most wellhead leaks was sending human workers down to fix them. In contrast, as the Institute for Southern Studies has reported, "the deeper you go, the more demanding the circumstances. The pressures are enormous, temperatures are low. You can't send divers down there to fix anything. The chemistry of the water is different than in shallow water. Fixes and repairs that work in shallow water don't work in deep water."[59]

The oil gushing from the Macondo wellhead was thus beyond the direct reach of any human being. Moreover, as the *Deepwater Horizon* disaster made clear, "[t]he deep ocean presents lots of problems, including the corrosive effect of salt water on metal rigs and drilling equipment," problems with the effects of "extreme pressure" on equipment, and "the fact that gases may become solid crystals . . . ."[60]

Even the oil itself does not behave the same at greater depths as it does on the surface. Oil discharging from the Macondo wellhead was subjected to pressures of over 125 atmospheres[61]—that is, pressures 125 times the pressure at sea level—and very low

57. *See* William Dent, *AAUS Deep Diving Standards*, *in* PROCEEDINGS OF ADVANCED SCIENTIFIC DIVING WORKSHOP: FEBRUARY 23–24, 2006, at 171, 174 (Michael A. Lang & N. Eugene Smith eds., 2006), *available at* http://archive.rubicon-foundation.org/xmlui/bitstream/handle/123456789/4669/SI_2006_18.pdf?sequence=3.

58. *See id.* at 186–87.

59. Michael T. Klare, *Oil Spill Reveals Dangers of Deep Water Drilling*, FACING SOUTH (June 4, 2010, 12:05 PM), http://www.southernstudies.org/2010/06/oil-spill-reveals-dangers-of-deep-water-drilling.html. For an overview of the technologies used in deepwater oil drilling and the risks involved at the Macondo well, see Mark A. Latham, *Five Thousand Feet and Below: The Failure to Adequately Regulate Deepwater Oil Production Technology*, 38 B.C. ENVTL. AFF. L. REV. 343, 346–53 (2011).

60. HUNTER, *supra* note 51, at 16.

61. "For every 33 feet (10 meters) of depth, the pressure increases by a further one atmosphere." Mark Moss, *Teaching Guide: Feeling Pressured*, PBS.ORG, http://www.pbs.org/saf/1102/teaching/teaching.htm (last visited Nov. 7, 2011). The Macondo wellhead was at 4130 feet; 4130 feet divided by 33 feet per atmosphere is 125.152 atmospheres of pressure.

temperatures. Released oil subjected to such pressures and low temperatures does not necessarily float to the surface. Studies reported in July 2011 confirmed that released oil behaves very differently at depth:

> Unlike a surface spill, from which these volatile compounds evaporate into the atmosphere, in the deep water under pressure, light hydrocarbon components predominantly dissolve or form hydrates, compounds containing water molecules. And depending on its properties, the resulting complex mixture can rise, sink, or even remain suspended in the water, and possibly go on to cause damage to seafloor life far from the original spill.[62]

Moreover, these studies noted that, in particular, the behavior of "light-weight, water-soluble hydrocarbons such as methane, benzene and naphthalene released from the base of the rig" might be critical to discovering and assessing the extent of deepwater environmental damage.[63]

Such differences were noted by observers responding to the *Deepwater Horizon* spill. They saw long strings of viscous material coming to the surface, dubbed "sea snot" and compared to egg drop soup, that appeared to be a mixture of oil, phytoplankton (microscopic plants that are the basis of marine food webs), and other organic material.[64] This material appeared to be the physical manifestation of differences in oil behavior that the July 2011 studies would later predict, and it signals potential long-term problems for the Gulf. As a report in *Nature* explained in April 2011:

> In shallow spills, oil tends to rise quickly to the surface, where it weathers, dissolves and evaporates in chemically predictable patterns. However, the largest drops of oil from the Deepwater Horizon well head took at least four hours to reach the surface, and smaller droplets rose much more slowly. During that long voyage, smaller droplets could have lost some of the lighter hydrocarbons that help to keep the various oil compounds from separating . . . .

62. *See Deep Below the* Deepwater Horizon *Oil Spill: New Molecular Model Better Explains Diffusion of Spill Under Water*, SCIENCEDAILY (July 18, 2011), http://www.sciencedaily.com/releases/2011/07/110718151549.htm.

63. *Id.*

64. Schrope, *supra* note 52, at 152–53.

> Still, the issue of how the oil transformed is a crucial one for researchers to address. The processes involved can affect the oil's toxicity and how long it is likely to stick around.[65]

In addition, three peer-reviewed studies confirmed that a "plume" of oil droplets and dissolved gases stretched several miles southwest of the wellhead between 3200 and 4200 feet below the surface.[66] While decomposition of this plume by bacteria is expected, "[c]hemical 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."[67] Almost a year later, *Nature* reported that "signs of significant damage are showing up farther from shore and in deeper water. It was a stroke of bad luck that the well happened to be located in the most species-rich part of the deep gulf."[68]

In addition, given the behavioral differences between oil released at great depths and oil released in surface spills, oil from the *Deepwater Horizon* disaster may still be collecting on and spreading across the seafloor.[69] Researchers have found a lumpy, cauliflower-like layer of brown material on the Gulf floor, which may be the congealed heavier components of oil released from the Macondo well—components that oil-digesting microbes have a harder time breaking down.[70] Moreover, "near to the well head, the layer shows little microbial activity, suggesting it will not break down quickly."[71]

Lack of knowledge regarding the oil spill's effect on the deepwater ecosystems of the Gulf is a recurring theme, even more than a year after the spill. For example, in an April 2011 interview with the *Orlando Sentinel*, NOAA Administrator Jane Lubchenco noted that "we still don't have a good handle on what the potential damage that was done by that subsurface oil and whether [deepwater plumes] were natural or caused by dispersants that were used."[72]

65. *Id.* at 153.

66. *See* 2011 BP DISASTER REPORT, *supra* note 1, at 182; *see also* Schrope, *supra* note 52, at 152 (reporting similar information about deepwater plumes).

67. 2011 BP DISASTER REPORT, *supra* note 1, at 182.

68. Schrope, *supra* note 52, at 152.

69. *See* 2011 BP DISASTER REPORT, *supra* note 1, at 182.

70. *See* Schrope, *supra* note 52, at 153.

71. *Id.*

72. Mike Thomas, *Gulf Oil Spill 1 Year Later: NOAA Boss Answers Mike Thomas' Questions*, ORLANDO SENTINEL (Apr. 19, 2011), http://tinyurl.com/7e6sdtf.

Nevertheless, NOAA has "video images that indicate there are spots on the [deep Gulf] seafloor where there is clear evidence of oil residue. But we don't have good information how extensive that is."[73] Part of the problem, Lubchenco emphasized, is the sheer size of the Gulf and the potentially affected area. Indeed, "[t]he challenge here is how to sample a huge, huge area, which is what the Gulf is."[74] Another problem is that there are numerous natural oil seeps and other oil spills in the Gulf, making it difficult to tie particular environmental damage at depth—such as videotaped damage to deep-sea coral reefs—to the BP oil spill.[75]

Nevertheless, there is no question that these deep marine ecosystems are "critical environmental habitat[s]." In Lubchenco's words, the deep Gulf ecosystem is "important to the functioning of the whole system. The coral and sponge communities that are down there are important ones. We know relatively little about them to begin with."[76] Other researchers emphasize that the Macondo well blowout and oil spill occurred in an area of particular species richness in the Gulf's depths—"some 1,728 species inhabit the region surrounding Deepwater Horizon at depths of between 1,000 and 3,000 metres, where the well is located."[77] As the *Nature* report summarized, one year after the oil spill, "[o]n the water's surface, there are no lasting impressions of the crisis, but not so below. The wreckage of one of the world's most advanced drilling rigs lies hidden on the sea floor, as do the ecological damages that are proving so challenging to assess."[78]

One lesson from the *Deepwater Horizon* oil spill, therefore, is that deepwater drilling in the Gulf placed the productive ecosystems that exist in its depths at risk before either those ecosystems or the risks of deepwater drilling—including the absolute need for different kinds of advanced technological emergency responses—were fully appreciated or even understood.[79]

73. *Id.* (alteration in original).

74. *Id.*

75. *See id.*

76. *Id.*

77. Schrope, *supra* note 52, at 154.

78. *Id.*

79. The Deepwater Horizon Commission summarized:

> Because the *Deepwater Horizon* spill was unprecedented in size, location, and duration, deepwater ecosystems were exposed to large volumes of oil for an extended period. It will take further investigation and more time to assess the

This Article suggests that natural resource damages—or, more precisely, the limits of natural resource damages as a remedy in situations like the *Deepwater Horizon* oil spill—could help prompt a change in how we think about regulating deepwater offshore oil drilling, a change to the resilience thinking discussed in Part IV. It is to those damages, therefore, that this Article now turns.

III. NATURAL RESOURCE DAMAGES UNDER THE CWA AND THE OPA, AND THE FEDERAL GOVERNMENT'S COMPLAINT

Federal law provides damages remedies for environmental injuries caused by oil spills under both the Federal Clean Water Act ("CWA")[80] and the Federal Oil Pollution Act of 1990 ("OPA").[81] These damages, referred to as natural resource damages, are available to the governments—the federal government, state governments, and tribes—who act as trustees for the natural resources at stake.[82]

Section A below discusses the available CWA damages remedies, while Section B discusses the damages remedies available under the OPA. Finally, Section C concludes by discussing the federal government's complaint in the suit it brought seeking these damages remedies from BP and several other defendants in the wake of the *Deepwater Horizon* disaster, giving particular attention to the informational deficiencies revealed in this complaint that make assessment of appropriate damages so challenging.

A. The Clean Water Act

Section 311 of the CWA governs liability for oil and other hazardous substances discharged into the nation's "navigable waters."[83] Specifically, this section seeks to effectuate Congress's policy "that there should be no discharges of oil or hazardous substances into or upon the navigable waters of the United States,

> 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.

2011 BP DISASTER REPORT, *supra* note 1, at 182.

80. *See* 33 U.S.C. §§ 1251–387 (2006).

81. *See id.* §§ 2701–62.

82. *See* Oil Pollution Act, 15 C.F.R. § 990.11 (2010); 43 C.F.R. § 11.14(rr) (2007) (defining "trustee" or "natural resource trustee" as used in the CWA and CERCLA).

83. 33 U.S.C. § 1321 (2006).

adjoining shorelines, or into or upon the waters of the contiguous zone, or in connection with activities under the Outer Continental Shelf Lands Act."[84] Because the Outer Continental Shelf Lands Act regulates offshore drilling,[85] these CWA liability provisions apply to the *Deepwater Horizon* oil spill. Moreover, § 311 explicitly prohibits discharges of oil "which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States"[86] or "which may be harmful to the public health or welfare or the environment of the United States, including but not limited to fish, shellfish, wildlife, and public and private property, shorelines, and beaches."[87]

Section 311 provides for several kinds of liability for discharged oil. Owners, operators, and persons in charge of offshore facilities are liable for administrative and civil penalties[88] if they discharge oil that violates the prohibition on threatening natural resources; civil penalties are up to $25,000 per day of violation or $1000 per barrel of oil.[89] Moreover, owners and operators who fail to remove the oil or to comply with the Environmental Protection Agency's ("EPA") orders incur civil penalties of $25,000 per day of violation or up to three times the amount that the federal government has to spend to clean up the discharged oil.[90] Failure to comply with other regulations warrants a civil penalty of $25,000 per day.[91] Grossly negligent dischargers are liable for civil penalties "of not less than $100,000, and not more than $3,000 per barrel of oil."[92] Finally, the government may recover all removal costs from the offending owner

84. *Id.* § 1321(b)(1). A "discharge" for purposes of this section includes "any spilling, leaking, pumping, pouring, emitting, emptying or dumping . . . ." *Id.* § 1321(a)(2). Given this broad definition, the *Deepwater Horizon* spill constitutes a "discharge" for purposes of § 311 liability.

85. *See* 43 U.S.C. §§ 1331–56.

86. 33 U.S.C. § 1321(b)(3).

87. *Id.* § 1321(b)(4).

88. *See id.* § 1321(b)(7)(A).

89. *See id.* The owner or operator of an offshore facility is, tautologically, "any person owning operating, or chartering by demise . . . such . . . an offshore facility," but it also includes, "in the case of any abandoned offshore facility, the person who owned or operated such facility immediately prior to such abandonment." *Id.* § 1321(a)(6). "'Person' includes an individual, firm, corporation, association, and a partnership." *Id.* § 1321(a)(7).

90. *See id.* § 1321(b)(7)(B).

91. *See id.* § 1321(b)(7)(C).

92. *Id.* § 1321(b)(7)(D).

or operator,[93] up to a cap of $50 million, but this cap is eliminated if the discharge of oil "was the result of willful negligence or willful misconduct within the privity and knowledge of the owner."[94] The owner's or operator's defenses to liability are limited to: "(A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of a third party without regard to whether any such act or omission was or was not negligent."[95]

Through regulations, the EPA has adopted what is known as the "sheen test" for determining whether discharges of oil are harmful to the public health or welfare (or environment) and hence violate § 311. Under this test, an owner or operator is liable under the CWA if an oil discharge violates applicable water quality standards or "[c]ause[s] a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or cause[s] a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines."[96] In addition, and relevant to the *Deepwater Horizon* oil spill, "[a]ddition of dispersants or emulsifiers to oil to be discharged that would circumvent the provisions of . . . [the relevant regulations] is prohibited."[97]

Originally, the regulations governing natural resource damages for discharges of oil under § 311 were the same as the regulations governing natural resource damages under the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA").[98] However, since the enactment of the OPA, NOAA's natural resource damages regulations supersede the EPA's natural resource damages regulations "with regard to oil discharges covered by the OPA."[99] Nevertheless, "[f]or natural resource damages resulting from a discharge or release of a mixture of oil and hazardous substances"—such as the mixture of oil and dispersant in many parts of the Gulf—"trustees must use . . . [the EPA's regulations] in order to obtain a rebuttable presumption" that the

93. *See id.* § 1321(b)(10).

94. *Id.* § 1321(f)(3).

95. *Id.*

96. 40 C.F.R. § 110.3 (2010).

97. *Id.* § 110.4.

98. *See* 43 C.F.R. § 11.10 (2010). CERCLA is codified at 42 U.S.C. §§ 9601–75 (2006).

99. 15 C.F.R. § 990.20(a) (2010).

damages claimed are consistent with the National Contingency Plan ("NCP").[100] As a result, CWA natural resource damages remain potentially relevant to the *Deepwater Horizon* oil spill, although in the BP oil spill litigation the United States has so far based its natural resource damages claims entirely on the OPA.

The EPA's natural resource damages regulations provide an extensive assessment procedure.[101] If the natural resource trustee[102] properly follows the assessment procedures, it may claim:

> (1) Damages as determined in accordance with this part and calculated based on injuries occurring from the onset of the release through the recovery period, less any mitigation of those injuries by response actions taken or anticipated, plus any increase in injuries that are reasonably unavoidable as a result of response actions taken or anticipated;
>
> (2) The costs of emergency restoration efforts under § 11.21 of this part;
>
> (3) The reasonable and necessary costs of the assessment, to include:
>
> > (i) The cost of performing the preassessment and Assessment Plan phases and the methodologies provided in Subpart D or E of this part; and
> >
> > (ii) Administrative costs and expenses necessary for, and incidental to, the assessment, assessment planning, and restoration, rehabilitation, replacement, and/or acquisition of equivalent resources planning, and any restoration, rehabilitation, replacement, and/or acquisition of equivalent resources undertaken . . . .[103]

100. *Id.* § 990.20(c).

101. *See* 43 C.F.R. § 11.13.

102. A trustee or natural resource trustee is defined as

> any Federal natural resources management agency designated in the NCP and any State agency designated by the Governor of each State, pursuant to section 107(f)(2)(B) of CERCLA, that may prosecute claims for damages under section 107(f) or 111(b) of CERCLA; or an Indian tribe, that may commence an action under section 126(d) of CERCLA.

Id. § 11.14(rr).

103. *Id.* § 11.15(a).

"Damages," for purposes of this provision, are "the amount of money sought by the natural resource trustee as compensation for injury, destruction, or loss of natural resources."[104]

The ultimate goal of these natural resource damages is either to "restor[e] or rehabilitat[e] the injured natural resources to a condition where they can provide the level of services available at baseline" or to accomplish "the replacement and/or acquisition of equivalent natural resources capable of providing such services."[105] "Services" in this context refer to ecosystem services—specifically, "physical and biological functions performed by the resource including the human uses of those functions. These services are the result of the physical, chemical, or biological quality of the resource."[106] The inclusion of services is designed to ensure that trustee officials have sufficient discretion to actually reestablish proper ecosystem functioning and make the public "whole."[107]

B. The OPA

In addition to natural resource damages available under § 311 of the CWA, natural resource damages are also available under the OPA. Congress enacted the OPA in response to the 1989 *Exxon Valdez* oil spill in Alaska.[108] The main effect of the OPA vis-à-vis the CWA is to expand responsible parties' potential liability for oil spills. Thus, regarding these parties' general liability, § 1002 states:

> Notwithstanding any other provision or rule of law, and subject to the provisions of this Act, each responsible party for a vessel or a facility from which oil is discharged, or which poses the substantial threat of a discharge of oil, into or upon the navigable waters or adjoining shorelines or the exclusive economic zone is liable for the removal costs and damages specified in subsection (b) of this

104. *Id.* § 11.14(l).

105. *Id.* § 11.82(b).

106. *Id.* § 11.14(nn).

107. Natural Resource Damage Assessments, 59 Fed. Reg. 14,262, 14,272–73 (Mar. 25, 1994) (to be codified at 43 C.F.R. pt. 11). For a discussion of ecosystem services losses in the context of the *Deepwater Horizon* oil spill, *see* Hirokawa, *supra* note 49, at 550–53 (explaining ecosystem services), 553–60 (discussing the Gulf's ecosystem services put at risk by the BP oil spill).

108. *See* S. REP. NO. 101-99, at 1–2 (1989), *reprinted in* 1990 U.S.C.C.A.N. 749, 750–51.

section that result from such incident.[109]

"[R]esponsible" parties covered by this provision include, relevant to the *Deepwater Horizon*'s offshore facility, "the lessee or the permittee of the area in which the facility is located or the holder of a right of use and easement granted under applicable State law or the Outer Continental Shelf Lands Act (43 U.S.C. § 1301–1356) for the area in which the facility is located," excluding governments.[110] The definition of a "discharge" of oil is similar to but broader than the definition of that term under the CWA, being "any emission (other than natural seepage), intentional or unintentional, and includ[ing], but . . . not limited to, spilling, leaking, pumping, pouring, emitting, emptying, or dumping."[111] Complete defenses are limited to "an act of God," "an act of war," and acts or omissions of unrelated third parties.[112]

Once a responsible party triggers the OPA, liability primarily revolves around removal costs and statutorily designated "damages." With respect to removal costs, responsible parties are liable for "all removal costs incurred by the United States, a State, or an Indian tribe" under federal or state law, and for "any removal costs incurred by any person for acts taken by the person which are consistent with the National Contingency Plan."[113] "[R]emoval costs" are "the costs of removal that are incurred after a discharge of oil has occurred" or the costs of preventing, minimizing, or mitigating a threatened oil spill.[114] "[R]emoval," in turn, "means containment and removal of oil or a hazardous substance from water and shorelines or the taking of other actions as may be necessary to minimize or mitigate damage to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches."[115] Under the OPA, unlike under the Clean Water Act, there is no limit on a responsible party's liability for removal costs in connection with an oil spill at an offshore facility that is not a deepwater port.[116]

109. 33 U.S.C. § 2702(a) (2006).
110. *Id.* § 2701(32)(C).
111. *Id.* § 2701(7).
112. *Id.* § 2703(a).
113. *Id.* § 2702(b)(1).
114. *Id.* § 2701(31).
115. *Id.* § 2701(30).
116. *See id.* § 2704(a)(3) (designating that an offshore facility is liable for "all removal

Damages under § 1002 include several forms of private and governmental damages: "[d]amages for injury to, or economic losses resulting from destruction of, real or personal property"; "[d]amages for loss of subsistence use of natural resources"; "[d]amages equal to the net loss of taxes, royalties, rents, fees, or net profit shares due to the injury, destruction, or loss of real property, personal property, or natural resources"; "[d]amages equal to the loss of profits or impairment of earning capacity due to the injury, destruction, or loss of real property, personal property, or natural resources"; and "[d]amages for net costs of providing increased or additional public services during or after removal activities, including protection from fire, safety, or health hazards, caused by a discharge of oil."[117] Most relevantly for this Article, § 1002 also explicitly provides for natural resource damages—that is, "[d]amages for injury to, destruction of, loss of, or loss of use of, natural resources, including the reasonable costs of assessing the damage."[118] Natural resource damages can be recovered "by a United States trustee, a State trustee, an Indian tribe trustee, or a foreign trustee."[119] "Natural resources," for purposes of these damage assessments, similar to the definition under the CWA regulations, include

> land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the exclusive economic zone), any State or local government or Indian tribe, or any foreign government.[120]

The OPA designates NOAA as the agency responsible for promulgating natural resource damages regulations and provides that

costs").

117. *Id.* § 2702(b)(2)(B)–(F).

118. *Id.* § 2702(b)(2)(A).

119. *Id.*; *see also id.* § 2706 (emphasizing who can recover natural resource damages and clarifying how natural resource trustees are appointed). Although natural resource damages claims in response to the *Deepwater Horizon* oil spill have so far focused on the United States and the Gulf states, several tribes are also potential claimants. For an overview of the relation of the oil spill to Gulf tribes, see Diane Courselle, *We (Used to?) Make a Good Gumbo—The BP* Deepwater Horizon *Disaster and the Heightened Threats to the Unique Cultural Communities of the Louisiana Gulf Coast*, 24 TUL. ENVTL. L.J. 19, 26–28, 37–39 (2010); Erick Rhoan, Comment, *The Rightful Position: The BP Oil Spill and Gulf Coast Tribes*, 20 SAN JOAQUIN AGRIC. L. REV. 173, 184–92 (2011).

120. 33 U.S.C. § 2701(20).

damage assessments done in accordance with the regulations "shall have the force and effect of a rebuttable presumption on behalf of the trustee in any administrative or judicial proceeding under this Act."[121]

The OPA generally caps the responsible parties' liability for statutory damages resulting from a release of oil, including capping natural resource damages from an offshore, nondeepwater port facility at $75 million.[122] However, the cap does not apply "if the incident was proximately caused by . . . gross negligence or willful misconduct of, or . . . the violation of an applicable Federal safety, construction, or operating regulation by, the responsible party," its agents and employees, or its contractual activities.[123] The cap also does not apply if the responsible party does not report the incident as required, does not cooperate with the removal activities, or does not comply with orders.[124]

NOAA's natural resource damages regulations implementing the OPA emphasize that natural resource damages "make the environment and public whole" by returning "the injured natural resources and services to baseline and [providing] compensation for interim losses of such natural resources and services from the date of the incident until recovery."[125] The regulations establish a preference for incident-based restoration but also allow for Regional Restoration Plans.[126] Moreover, in pursuing natural resource restoration, trustees must ensure compliance with other environmental and natural resources laws, including the federal Endangered Species Act, the Coastal Zone Management Act, the Migratory Bird Treaty Act, the National Marine Sanctuaries Act, the National Historic Preservation Act, the Marine Mammal Protection Act, and the Archaeological Resources Protection Act.[127] Importantly, the regulations do not require active restoration, and

121. *Id.* § 2706(e)(2).
122. *See id.* § 2704(a)(3).
123. *Id.* § 2704(c)(1).
124. *See id.* § 2704(c)(2).
125. 15 C.F.R. § 990.10 (2010).
126. *See id.* § 990.15(b).
127. *See id.* § 990.24(b).

trustees may allow natural restoration to take its course if costs do not justify active restoration.[128]

C. The Federal Government's Complaint and Problems Because of Insufficient Information

Despite the uncertainties surrounding the *Deepwater Horizon*'s immediate and long-term damages to the natural environment of the Gulf, the United States filed its complaint against BP and several other defendants in the U.S. District Court for the Eastern District of Louisiana on December 15, 2010.[129] The complaint refers to the BP oil spill as "one of the worst environmental disasters in American history," which caused "grave harm to natural resources across several States and related waters."[130] It seeks both removal costs and damages under the OPA and civil penalties under the Clean Water Act.[131] The United States claims damages in excess of $75 million under the OPA[132] and charges the defendants with gross negligence and willful misconduct[133] to justify exceeding the OPA cap.

Perhaps most interestingly for this Article, however, is the fact that the United States' complaint fully embraces the indeterminacy of natural resource damages:

> Discharged oil and some of the response activities to address the discharges of oil have resulted in injury to, loss of, loss of use of or destruction of natural resources in and around the Gulf of Mexico and along adjoining shorelines of the United States, and also have impaired or caused the loss of services that those resources provide. *The full extent of potential injuries, destruction, loss and loss of services is not yet fully known and may not be fully known for many years.* On information and belief, resources and resource services that have been injured, destroyed, or lost include, but are not limited to, hundreds of miles of coastal habitats, including salt marshes, sandy beaches, and mangroves; a variety of wildlife, including birds, sea turtles, and marine mammals; lost human-use opportunities associated with various natural resources in the Gulf

128. *See id.* §§ 990.52(c), 990.53, 990.54.

129. *See generally* Complaint, United States v. BP Exploration & Prod., Inc., No. 2:10-cv-04536 (E.D. La. Dec. 15, 2010).

130. *Id.* ¶¶ 1–2.

131. *See id.* ¶¶ 3–4.

132. *See id.* ¶ 67.

133. *See id.* ¶ 69.

> region, including but, not limited to fishing, swimming, beach-going, and viewing of birds and wildlife; and waters of the Gulf of Mexico, including various biota, benthic communities, marine organisms, coral, fish, and water-column habitat.[134]

Moreover, the United States explicitly reserved its rights under the CWA, OPA, and other statutes and maritime law to pursue additional penalties and damages.[135] The federal government and the states are currently conducting a major natural resource damages assessment ("NRDA"),[136] but the process is expected to take years, and the Programmatic Environmental Impact Statement for restoration efforts is not expected until 2012.[137]

More fundamentally, there are many reasons to be skeptical that the NRDA process will be able to fulfill the basic purposes of natural resource damages in the context of the *Deepwater Horizon* disaster. As discussed, natural resource damages embody a legal recognition that some forms of pollution, like major oil spills, cause both short-term and long-term damage to species and ecosystems, that this damage matters to human beings as well as to the environment, and that this damage involves substantial economic loss, including costs related to restoration and replacement. Nevertheless, natural resource damages are notoriously difficult to assess and quantify, and those difficulties may be insurmountable for the *Deepwater Horizon* oil spill, especially with respect to deepwater ecosystems. The Deepwater Horizon Commission has recognized these difficulties:

> 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 damages to the appropriate restoration projects takes considerable time. A typical damage assessment can take years. Two sets of determinations—one concerning baseline conditions against which damages to each species or habitat will be assessed and another

134. *Id.* ¶ 66 (emphasis added).

135. *See id.* ¶ 92.

136. *See* Deepwater Horizon *Incident Natural Resource Damage Assessment*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., http://oceanservice.noaa.gov/news/weeklynews/june10/nrda-deepwater.html (last modified July 1, 2010).

137. *See* NAT'L OCEANIC AND ATMOSPHERIC ADMIN., PUBLIC SCOPING FOR PREPARATION OF A PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR THE *DEEPWATER HORIZON* BP OIL SPILL 9 (2011), *available at* http://tinyurl.com/3jv356c.

concerning the quantification of those damages—are particularly difficult and consequential in terms of the overall results.[138]

The primary difficulty in assessing natural resource damages for the Gulf's deepwater ecosystems, as Jane Lubchenco's April 2011 interview reveals, is that baseline information about these ecosystems is simply unavailable. Under both the CWA and OPA oil spill regulations, natural resource damages are measured against an explicit baseline—"the condition or conditions that would have existed at the assessment area had the discharge of oil . . . under investigation not occurred" under the CWA,[139] or "the condition of the natural resources and services that would have existed had the incident not occurred" under the OPA.[140] Such measurements, however, presume sufficient prior knowledge about the damaged ecosystem to determine what is different after the oil spill. Such prior knowledge is generally lacking for deepwater ecosystems (and many not-so-deep marine ecosystems, as well). Moreover, conditions in the Gulf make it particularly difficult to presume that all or even most of the oil damage found was caused by the Macondo well discharge—unlike, for example, the case of the 2011 Yellowstone oil pipeline leak[141]—because natural oil seeps, multiple smaller spills, and discharges of oil from hundreds of other offshore rigs are part of the baseline conditions.

This is the dilemma currently facing the United States government, the Gulf states, and certain tribes who are pursing natural resource damages for the *Deepwater Horizon* spill. Nevertheless, even if they acquire sufficient information to establish "adequate" natural resource damages for the Gulf's deepwater ecosystems, thereby allowing them to measure damages against an informed baseline, it is still uncertain whether the Gulf is resilient enough to recover from the oil spill. Notwithstanding this major uncertainty, though, the current legal regime—including offshore

138. 2011 BP DISASTER REPORT, *supra* note 1, at 183–84.

139. 43 C.F.R. § 11.14(e) (2010).

140. 15 C.F.R. § 990.30 (2010); *see also id.* § 990.52(a) ("In addition to determining whether injuries have resulted from the incident, trustees must quantify the degree, and spatial and temporal extent of such injuries relative to baseline.").

141. *See, e.g.*, Tara Thean, *Why the Yellowstone Spill Is So Tough to Clean Up*, ECOCENTRIC: TIME BLOG (July 11, 2011, 5:00 AM), http://ecocentric.blogs.time.com/2011/07/11/why-the-yellowstone-oil-spill-is-so-tough-to-clean-up/ (actively comparing the two oil spills but squarely blaming ExxonMobil for the damage to the Yellowstone River).

drilling regulations and available natural resource damages remedies—fails to consider the important concept of resilience. The next Part of this Article thus argues that resilience thinking should become one of the bedrock principles underlying the regulation of offshore drilling and oil spill remedies.

IV. INCORPORATING RESILIENCE THINKING TO CLOSE THE LIABILITY/REALITY GAP

Ecological resilience and resilience theory acknowledge that ecosystems are dynamic—not, as prior theories had assumed, inherently stable systems tending toward an equilibrium.[142] Resilience theory recognizes that there are at least three different ways in which ecosystems experience and respond to change and perturbation—three different aspects of "resilience."[143] The first and most common understanding of resilience refers to an ecosystem's ability to absorb change and persist in function and relationships.[144] This sense of resilience refers to "the rate or speed of recovery of a system following a shock."[145] As a practical matter in the law of natural resource management, the law tends to expect that ecosystems will be resilient in this first sense—that is, the law assumes that ecosystems will generally successfully absorb any human-induced perturbations of the system. As a result, natural resources law is what I will term "first sense resilience dependence," but that dependence reflects a truncated understanding of ecosystems' resilience and capacity for change.

Importantly, however, the second aspect of resilience theory acknowledges that ecosystems can exist in multiple states rather than stabilizing around a single equilibrium state; as a result, changes and disturbances can "push" ecosystems over thresholds from one ecosystem state to another.[146] This second sense of resilience "assumes multiple states (or 'regimes') and is defined as the magnitude of a disturbance that triggers a shift between alternative states."[147] For example, the boreal forests of Canada can exist in at

142. *See* Lance H. Gunderson & Craig R. Allen, *Why Resilience? Why Now?*, *in* FOUNDATIONS OF ECOLOGICAL RESILIENCE xiii–xv (Lance H. Gunderson et al. eds., 2010).

143. *See id.* at xv (citation omitted).

144. *See id.*

145. *Id.*

146. *See id.*

147. *Id.* at xv–xvi.

least two states with respect to spruce budworms: a "no outbreak" state "characterized by low numbers of budworm and young, fast-growing trees," and an "outbreak" state "characterized by high numbers of budworm and old, senescent trees."[148] The shift between the two appears to relate to an increase in canopy volume, which in turn affects bird populations and the birds' ability to control the pest.[149] Regime-shift models can also help to explain outbreaks of some human diseases.[150] However, natural resources law and policy generally do not acknowledge this second sense of resilience, and, as a result, it generally does not incorporate mechanisms for acknowledging, responding to, or even trying to avoid ecological regime shifts.

Finally, resilience theory also acknowledges "the surprising and discontinuous nature of change, such as the collapse of fish stock or the sudden outbreak of spruce budworms in forests."[151] In other words, the long-time persistence of an ecosystem (or collection of multiple ecosystems) like the Gulf of Mexico in an apparently stable, productive ecosystem state is absolutely no guarantee that humans can continue to disturb and abuse the system and expect only a gradual or linear response.

As was true for the second sense of resilience, natural resource law in general and marine resources law in particular do not deal well with the possibility of sudden and dramatic ecosystem changes. Nevertheless, such regime shifts have been documented for a number of marine ecosystems. For example,

> In Jamaica, the effects of overfishing, hurricane damage, and disease have combined to destroy most corals, whose abundance has declined from more than 50 percent in the late 1970s to less than 5 percent today. A dramatic phase shift has occurred, producing a system dominated by fleshy macroalgae (more than 90 percent cover). Immediate implementation of management procedures is necessary to avoid further catastrophic damage.[152]

Similarly, the presence or absence of sea otters can significantly influence the structure and function of Alaskan kelp forests because

148. *Id.* at xvi.

149. *See id.*

150. *See id.*

151. *Id.* at xv.

152. Terence P. Hughes, *Catastrophes, Phase Shifts, and Large-Scale Degradation of a Caribbean Coral Reef*, 265 SCI. 1547, 1547 (1994).

the otters, when present, control sea urchin populations, allowing for more extensive coral growth.[153] In some locations, moreover, "sea urchin population changes in response to sea otter predation were rapid and extreme" and could result in "short-term changes in kelp density."[154]

The current law, policy, and remedy regime for offshore oil drilling effectively presumes that marine ecosystems have virtually unlimited first-sense resilience with respect to oil spills—in crudest terms, that restoration will always be possible, and perhaps even through entirely natural means.[155] Our experience with the last large oil spill in U.S. waters, however, suggests otherwise.

More than twenty years before the *Deepwater Horizon* disaster, on March 24, 1989, the oil tanker *Exxon Valdez* ran aground in Prince William Sound, Alaska, spilling approximately eleven million gallons of crude oil.[156] Although the oil eventually affected about 1300 miles of Alaskan coastline,[157] it is important to remember that, in the context of the *Deepwater Horizon* spill, the *Exxon Valdez* was a relatively simple—and relatively small—*surface* release of oil. Even so, more than twenty years later, according to NOAA, "While the vast majority of the spill area now appears to have recovered, pockets of crude oil remain in some locations, and there is evidence that some damage is continuing."[158] More specifically, NOAA reports that, overall, the Prince William Sound ecosystem has proven resilient in the first sense—it has been able to absorb most changes and persist in function and relationships.[159]

153. James Estes & David O. Duggins, *Sea Otters and Kelp Forests in Alaska: Generality and Variation in a Community Ecological Paradigm*, 65 ECOLOGICAL MONOGRAPHS 75, 75 (1995).

154. *Id*. at 87.

155. *See* discussion *supra* notes 124–130 and accompanying text.

156. *See Office of Exxon Valdez Oil Spill (EVOS) Damage Assessment and Restoration*, NAT'L MARINE FISHERIES SERV. ALASKA REG'L OFFICE, http://www.fakr.noaa.gov/oil/ (last visited Aug. 8, 2011).

157. *See id*.

158. *Id*.

159. Specifically:

> Many shorelines that were heavily oiled and then intensively cleaned now appear much as they did before the spill. Most gravel beaches where the oiled sediments were excavated and pushed into the surf zone for cleansing have returned to their normal shape and distribution on the shore. Beaches that had been stripped of plants and animals by the toxic effects of oil and by the intense cleanup efforts show extensive recolonization and are similar in appearance to areas that were unoiled.

Nat'l Oceanic & Atmospheric Admin., *Prince William's Oily Mess: A Tale of Recovery*, NOAA

Nevertheless, NOAA has also cautioned that "impacts from the spill remain":

- Deeply penetrated oil continues to visibly leach from a few beaches, such as Smith Island.
- In some areas, intertidal animals, such as mussels, are still contaminated by oil, affecting not only the mussels but any animals (including people) that eat them.
- Some rocky sites that were stripped of heavy plant cover by high-pressure, hot-water cleaning remain mostly bare rock.
- Rich clam beds that suffered high mortalities from oil and extensive beach cleaning have not re-colonized to their previous levels.[160]

Notably, NOAA concludes that "Prince William Sound has made a remarkable recovery from a severe injury, but it remains an *ecosystem in transition*."[161]

In other words, twenty years after a major surface spill of oil, Prince William Sound has not fully recovered and, indeed, may never do so. Its first-sense resilience to oil spills is incomplete, or at least operates over substantial time scales, and we may eventually find (or decide) that ecological communities within the Sound have in fact experienced resilience in the second sense: an ecological regime shift. As one possible example, NOAA reports that "[b]eginning in 1990, scientists saw the cover of rockweed increase steadily at oiled sites—until 1994, that is. From 1994 through 1995, there appeared to be a noticeable decline in cover, especially at sites that had been oiled."[162] While scientists are still searching for an explanation, the three candidates—a disruption in the normal mix of rockweed ages, an explosion in the populations of grazers such as periwinkle snails, or a longer-term toxic effect of the oil[163]—all suggest that the oil spill may have induced (or at least threatened) a regime shift.

These results suggest that we should be very concerned for the Gulf ecosystems affected by the Macondo well blowout. First, and as

OCEAN SERV. EDUC., http://oceanservice.noaa.gov/education/stories/oilymess/oily02_impacts.html (last updated Mar. 25, 2008).

160. *Id.*

161. *Id.*

162. *Id.*

163. *See id.*

this Article has emphasized throughout, unlike the *Exxon Valdez* spill, the *Deepwater Horizon* oil spill occurred at great depth, and the oil behaved unusually compared to oil released on the surface. Second, considerably more toxic dispersants were used in connection with the Gulf oil spill than the Alaska oil spill.[164] Third, humans could intervene almost immediately to begin cleaning the rocky substrate in Prince William Sound, but human intervention for many of the important affected Gulf ecosystems, especially the deepwater ones (but even for shallower coral reefs), remains impossible.

Finally, and perhaps most importantly, the Prince William Sound was and remains a far less stressed ecosystem than the Gulf of Mexico. In 2008, for example, NOAA stated that "[d]espite the remaining impacts of the [still then] largest oil spill in U.S. history, Prince William Sound remains a relatively pristine, productive and biologically rich ecosystem."[165] To be sure, the Sound was not completely unstressed, and "[w]hen the *Exxon Valdez* spill occurred in March 1989, the Prince William Sound ecosystem was also responding to at least three notable events in its past: an unusually cold winter in 1988–89; growing populations of reintroduced sea otters; and a 1964 earthquake."[166] Nevertheless, the Gulf of Mexico is besieged by environmental stressors at another order of magnitude (or two), reducing its resilience to disasters like the *Deepwater Horizon* oil spill. As the Deepwater Horizon Commission detailed at length, the Gulf faces an array of long-term threats, from the loss of protective and productive wetlands along the coast to hurricanes to a growing "dead zone" (hypoxic zone) to sediment starvation to sea-level rise to damaging channeling to continual (if smaller) oil releases from the thousands of drilling operations.[167] In the face of this plethora of stressors, even the Commission championed a kind of resilience thinking, recognizing that responding to the oil spill alone was not enough. It equated restoration of the Gulf to "restored resilience," arguing that it "represents an effort to sustain these

164. *See* 2011 BP DISASTER REPORT, *supra* note 1, at 144 (noting that 5500 gallons of dispersants were used in response to the *Exxon Valdez* oil spill, compared to over 300,000 gallons used in response to the Gulf oil spill in the first two weeks alone).

165. Nat'l Oceanic and Atmospheric Admin., *supra* note 159.

166. *Id.*

167. *See* 2011 BP DISASTER REPORT, *supra* note 1, at 197–206.

diverse, interdependent activities [fisheries, energy, and tourism] and the environment on which they depend for future generations."[168]

A number of commentators have catalogued the failure of the legal and regulatory systems governing the *Deepwater Horizon* platform and the Macondo well operations.[169] The Deepwater Horizon Commission similarly noted that the *Deepwater Horizon*'s "demise signals the conflicted evolution—and severe shortcomings—of federal regulation of offshore oil drilling in the United States."[170] In its opinion, "[t]he *Deepwater Horizon* blowout, explosion, and oil spill did not have to happen."[171] The Commission's overall conclusion was two-fold. First, "[t]he record shows that without effective government oversight, the offshore oil and gas industry will not adequately reduce the risk of accidents, nor prepare effectively to respond in emergencies."[172] Second, "government oversight, alone, cannot reduce those risks to the full extent possible. Government oversight . . . must be accompanied by the oil and gas industry's internal reinvention: sweeping reforms that accomplish no less than a fundamental transformation of its safety culture."[173]

Reforms to government oversight are underway. One of the immediate legal consequences of the disaster, for example, was the comprehensive replacement of the former Minerals Management Service in order to separate its regulatory and revenue-generating functions.[174] Within two months of the *Deepwater Horizon* sinking, the head of the Minerals Management Service resigned, and the Agency's functions were transferred to the brand new Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE, or BOE, for short).[175] That new agency, moreover, will further separate its functions into three agencies—the Bureau of Ocean Energy Management (BOEM), the Bureau of Safety and Environmental Enforcement (BSEE), and the Office of Natural Resources Revenue (ONRR)—to "improve the management,

168. *Id.* at 213.

169. *See* sources cited *supra* note 39.

170. 2011 BP DISASTER REPORT, *supra* note 1, at 55.

171. *Id.* at 217.

172. *Id.*

173. *Id.*

174. *See id.* at 55–56.

175. *See Frequently Asked Questions*, BUREAU OF OCEAN ENERGY MGMT., REGULATION & ENFORCEMENT, http://tinyurl.com/3h5t84d (last visited July 20, 2011).

oversight, and accountability of activities on the [Outer Continental Shelf]; ensure a fair return to the taxpayer from royalty and revenue collection and disbursement activities; and provide independent safety and environmental oversight and enforcement . . . ."[176]

The Deepwater Horizon Commission had several other recommendations for governance reforms, although it largely chose to hew close to existing law and policy, tinkering with existing structures rather than promoting a different and more precautionary philosophical approach.[177] More important for purposes of this Article, however, is the Commission's unquestioned assumption of the Gulf's continuing ability to recover from massive oil spills (resilience in the first sense). In particular, its environmental recommendations seek to ensure, *inter alia*, that "[t]he environment and the economy of the Gulf region recovers as completely and as quickly as possible, not only from the direct impacts of the spill, but from the decades of degradation that proceeded it."[178]

This is natural resources law's *first-sense resilience dependence* in action—an unwarranted assumption that human actions are unlikely to push ecosystems over ecosystem thresholds into different structures and functions that, generally, will have significantly reduced value to the humans that depend on the current ecological state. As William C. Clark, Dixon D. Jones, and C.S. Holling have noted, "A system which is globally stable is admirable for blind trial-and-error experimentation: it will always recover from any perturbation. It is this paradigm of an infinitely forgiving Nature that has been assumed implicitly in the past . . . ."[179] Nevertheless, as a result of this first-sense resilience dependence, the laws and policies governing offshore oil drilling (and many other kinds of natural resource management) base their regulatory and liability regimes on the assumption that violators can in fact "make the public and the environment whole."[180]

176. *Id.*

177. *See* 2011 BP DISASTER REPORT, *supra* note 1, at 249–91.

178. *Id.* at 275.

179. William C. Clark et al., *Lessons for Ecological Policy Design*, *in* FOUNDATIONS OF ECOLOGICAL RESILIENCE, *supra* note 142, at 331, 333.

180. VALERIE ANN LEE & P.J. BRIDGEN, THE NATURAL RESOURCE DAMAGE ASSESSMENT DESKBOOK: A LEGAL AND TECHNICAL ANALYSIS § 14.2.1, at 326 (2002).

What would happen instead if we incorporated full resilience theory into our laws? As Brian Walker and David Salt have discussed at length, "Resilience thinking presents an approach to managing natural resources that embraces human and natural systems as complex systems continually adapting through cycles of change."[181] In addition to adopting a systems perspective on ecosystem management, resilience thinking fully incorporates the implications of resilience in the second sense (potential ecological regime shifts)—the recognition that "[s]ocio-ecological systems can exist in more than one kind of stable state. If a system changes too much, it crosses a threshold and begins behaving in a different way, with different feedbacks between its component parts and a different structure."[182] Resilience thinking therefore seeks not—as is true under current management paradigms—to tweak the operations of an ecosystem in order to optimize particular products or functions[183] (for example, oil production in the Gulf). Rather, it seeks to more humbly recognize that "[t]he complexity of the many linkages and feedbacks that make up a socio-ecological system is such that we can never predict with certainty what the exact response will be to any intervention in the system."[184] In other words, resilience thinking acknowledges what is particularly true with respect to marine ecosystems: most of the time, we have only the most simplistic of understandings of what our actions do to the ecosystems that we both impact and depend upon.[185]

Operationalizing resilience thinking is not easy, especially given current natural resources management norms and paradigms. However, some of the ways in which it might make a difference to our current laws governing offshore oil drilling are:

- ***Comprehensive ecosystem surveys should precede resource development and exploitation rather than follow them.*** While resilience thinking teaches us that we will never

181. BRIAN WALKER & DAVID SALT, RESILIENCE THINKING: SUSTAINING ECOSYSTEMS AND PEOPLE IN A CHANGING WORLD 10 (2006).

182. *Id.* at 11.

183. *See id.* at 30–31.

184. *Id.* at 34–35.

185. For this and other reasons, John Nagle has actively promoted humility as an appropriate environmental ethic. John Copeland Nagle, *From Swamp Drainage to Wetlands Regulation to Ecological Nuisances to Environmental Ethics*, 58 CASE W. RES. L. REV. 787, 811 (2008).

completely understand the complex functioning, interactions, and responses of ecosystems—for example, Clark, Jones, and Holling consider management "surprises" inevitable[186]—that acknowledgement of human limitation should not become an excuse for operating completely blindly. Indeed, the process of learning, often embodied in the inclusion of adaptive management, is generally considered a critical component of resilience thinking and management.[187] Especially for activities in the oceans (and within the oceans, especially for activities at great depth), would-be resource exploiters should be required to comprehensively survey, at the very least, the ecosystems within which they will be working to provide a baseline for measuring the changes that their later activities might effect.

- ***Systemic risk is as important as individual risk***. Notwithstanding the National Environmental Policy Act's requirement that federal permitting agencies consider cumulative impacts to the environment,[188] we currently evaluate the risks of offshore oil drilling primarily with respect to individual oil drilling operations in connection with individual permits and leases. As the Deepwater Horizon Commission recognized, however, the larger systemic context of such drilling is also important, and perhaps arguably more so. From a resilience perspective, a drilling operation that uses the only oil rig in a pristine marine environment is an inherently different risk problem than the *Deepwater Horizon*'s situation of being one of thousands of similar rigs in a pervasively and multiply stressed Gulf. As Clark, Jones, and Holling have suggested, our trial-and-error experiments with Nature in our first-sense resilience

186. Clark et al., *supra* note 179, at 333.

187. *See* Craig R. Allen et al., *Commentary on Part One Articles*, *in* FOUNDATIONS OF ECOLOGICAL RESILIENCE, *supra* note 142, at 3, 8; Clark et al., *supra* note 179, at 333; WALKER & SALT, *supra* note 181, at 33; J.B. Ruhl, *General Design Principles for Resilience and Adaptive Capacity in Legal Systems—with Applications to Climate Change Adaptation*, 89 N.C. L. REV. 1373, 1396 (2011).

188. *See* 42 U.S.C. § 4332(2)(C) (2006).

dependence mode "now threaten[] errors larger and more costly than society can afford."[189] Resilience thinking should more forcibly insist on multilayered systemic awareness, promoting limits on how much exploitation should be occurring simultaneously and encouraging more gradual resource development over longer periods of time.

- ***Risk to the environment should be presumed, even when all actors follow all best practices.*** Our current first-sense resilience dependency produces laws that assume that ecosystems can be fixed—and, perhaps more importantly, as embodied in the OPA natural resource damages regulations, that natural processes will often be able to restore themselves without human effort. Resilience thinking, in contrast, effectively assumes that ecosystems could suddenly shift to a new regime at any time for any number of reasons that we do not understand and may not even be able to anticipate—the combined potential of the second and third conceptions of resilience. In the words of Clark, Jones, and Holling, "if a system has multiple regions of stability, then Nature can seem to play the practical joker rather than the forgiving benefactor."[190] To exaggerate the differences in outlook just a bit, our current paradigm presumes that most ecosystems can cope with most human activities, while resilience thinking presumes that all changes to an ecosystem are at least potentially completely destabilizing—i.e., inherently risky, with the outer limits of that risk being potentially massive. To translate this change in presumption into legalese, full resilience thinking promotes a policy framework where most human activities in the environment could be—and perhaps should be—considered inherently dangerous activities.

189. Clark et al., *supra* note 179, at 333.
190. *Id*.

As every first-year law student learns, engaging in inherently dangerous activities tends to subject the actor to strict and fairly absolute liability for the kinds of harm that made the activity inherently dangerous.[191] Under resilience thinking, those kinds of harm would include all of the unpredictable and unexpected changes to the ecosystem that might occur as a result of a disaster like the *Deepwater Horizon* oil spill, up to and including a substantial shift in ecosystem regime or ecosystem collapse.

While full implementation of an "inherently dangerous activity" legal regime for all marine activities is unlikely, the case is fairly strong for deep sea oil exploration and drilling. It is at least worth pondering what such a consequence of resilience thinking might mean for risk assessment and behavioral incentives in this context. If nothing else, one would predict under such a new view of potential liability that oil companies' insurers might begin charging premiums that more accurately reflect the potentially catastrophic liability that resilience-minded regulations and policies would make legally cognizant—and might insist on the much more precautionary and safety-minded approach to offshore oil drilling that a multitude of commentators and the Deepwater Horizon Commission have sought in the wake of the *Deepwater Horizon* disaster.

V. CONCLUSION

The second and third senses of resilience, and the socio-ecological risks for humans that they underscore, should not be foreign concepts in the regulation of the marine environment, including (and perhaps especially) when it comes to regulating the offshore oil and gas exploration and drilling taking place at ever-increasing depths. Nor should the possibility that the cumulative stresses to the Gulf of Mexico have pushed its ecosystems to the brink of ecosystem thresholds be ignored in our regulatory regimes.

By acknowledging that ecosystems are dynamic and subject to sudden and fairly catastrophic (at least from a human perspective) changes, full resilience thinking provides a path away from the trap of first-sense resilience dependence. Specifically, full resilience thinking recognizes that exploitative activities that affect the Gulf—not just deep sea oil drilling but also fishing and farming up the Mississippi River—put *all* of the human beings who depend on the

191. *See* RESTATEMENT (SECOND) OF TORTS § 519 (1977).

Gulf's ecosystem services, as well as the ecosystems themselves, at collective risk of catastrophic ecosystem collapse. A liability regime based on these unavoidable and potentially massive environmental risks would likely protect the Gulf of Mexico better than our current regime of natural resource damages, especially when injury occurs in the Gulf's murky depths.