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ARTICLE

A PRECAUTIONARY TALE: ASSESSING ECOLOGICAL DAMAGES AFTER THE *EXXON VALDEZ* OIL SPILL

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INTRODUCTION

To some, the grounding of the *Exxon Valdez* is an old story: An Exxon supertanker runs aground Bligh Reef in the dead of night on March 24, 1989. Eleven million gallons of crude oil are released into one of the most delicate and spectacular marine ecosystems on the planet.[1] The resulting oil slick stretches 500 miles—the coastline equivalent of Massachusetts to North Carolina—and adversely impacts 1,300 miles of shoreline.[2] Ten thousand workers and about $2.1 billion are dedicated to cleanup efforts.[3] The livelihood of over 34,000 fishermen is jeopardized, forcing some to

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1. *EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL, 2009 STATUS REPORT 4 (2009), *available at* http://www.evostc.state.ak.us/Universal/Documents/Publications/20th%20Anniversary%20Report/2009%20Status%20Report%20(Low-Res).pdf [hereinafter TRUSTEE COUNCIL, 2009 REPORT]; *see also Exxon Valdez* Oil Spill Trustee Council, Questions and Answers, http://www.evostc.state.ak.us/facts/qanda.cfm (last visited Feb. 11, 2010) [hereinafter Trustee Council, Questions].

2. Trustee Council, Questions, *supra* note 1; *see also* Evelyn D. Brown, Brenda L. Norcross & Jeffrey W. Short, *An Introduction to Studies of the Effects of the* Exxon Valdez *Oil Spill on Early Life History Stages of Pacific Herring*, Clupea Pallasi*, in Prince William Sound, Alaska*, 53 CAN. J. FISH & AQUATIC SCI. 2337, 2338 (1996) (noting that an estimated 40–45 percent of the oil spilled became beached within Prince William Sound).

3. Trustee Council, Questions, *supra* note 1; *see also* TRUSTEE COUNCIL, 2009 REPORT, *supra* note 1, at 5 (noting that "[a]t one point more than 11,000 people were working on cleanup").

change careers or relocate over time.[4] The social fabric of native communities unravels.[5]

Though the story of the grounding, litigation, devastation, and cleanup has been finding its way into the news media for over two decades, the story is not complete.[6] Humbling as it is, our understanding of the ecological damages that have resulted from the *Exxon Valdez* oil spill is still unfolding.[7]

Twenty years after the *Exxon Valdez* ran aground on Bligh Reef, the *Exxon Valdez* Trustee Council[8] continues to identify two species as "not recovered"—meaning that the species show little or no signs of improvement. One of those species is the Pacific herring.[9] As a keystone species, herring is central to the marine food web at all of its life stages. In fact, herring is so significant to the Prince William Sound ecosystem that the

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4. Wesley Loy, *Decision Torments Cordova Fishermen*, Anchorage Daily News, June 26, 2008 (discussing impacts of spill to Cordova fishermen, forcing some to enter hotel industry); Byron Pitts, *Exxon Valdez Oil Spill: 20 Years Later*, CBS Evening News, Feb. 2, 2009, http://www.cbsnews.com/stories/2009/02/02/eveningnews/main4769329.shtml (noting that 8,000 plaintiffs have liens on their settlements); *Town Braces for High Court Oil Spill Hearing*, USA Today, Feb. 25, 2008, http://www.usatoday.com/news/washington/environment/2008-02-5-exxon-hearing_N.htm (describing stories of devastation among some fishermen).

5. For detailed research and discussions about the cultural and psychological impacts of the Exxon Valdez Oil Spill on Native Alaskan communities, see Duane A. Gill & J. Steven Picou, The *Exxon Valdez* Disaster: Reading on a Modern Social Problem 167–87 (J. Steven Picou et al. eds., 1997); Duane A. Gill & J. Steven Picou, The *Exxon Valdez* Oil Spill and Chronic Psychological Stress, *in* Proceedings of the *Exxon Valdez* Oil Spill Symposium 879 (Stanley D. Rice et al. eds., 1996).

6. More than twenty years after the spill, some species have yet to recover. Trustee Council, 2009 Report, *supra* note 1, at 16. Ecological impacts are still being discovered. *Id.* at 10. Damage disputes remain unresolved. *Infra* note 137 (noting that Exxon has yet to respond to the federal government's demand for an additional $92 million under the reopener provision of the natural resource damages settlement).

7. Recent research has shown that lingering oil persists in the Prince William Sound environment at toxicity levels almost as high as a few weeks after the spill. *See* Trustee Council, 2009 Report, *supra* note 1, at 10; *Oil Plagues Sound 20 Years After* Exxon Valdez, msnbc.com, June 4, 2009, http://www.msnbc.msn.com/id/29838444; Bryan Walsh, *Still Digging Up* Exxon Valdez *Oil, 20 Years Later*, Time, June 4, 2009, http://www.time.com/time/health/article/0,8599,1902333,00.html. In fact, "The amount of *Exxon Valdez* oil remaining substantially exceeds the sum total of all previous oil pollution on beaches in Prince William Sound, including oil spilled during the 1964 earthquake." Trustee Council, 2009 Report, *supra* note 1, at 10. Because of lingering oil, some species such as the sea otter continue to be exposed to the toxic oil. *Id.* at 12–13. In addition to lingering oil, slower than expected recovery and evidence of unusual social breakdown within one resident orca whale population has caught the attention of researchers. *Id.* at 14–15.

8. The *Exxon Valdez* Trustee Council was formed to oversee the restoration of the injured Prince William Sound ecosystem. The Trustee Council administers the $900 million natural resource damages settlement; it consists of three state and three federal trustees. The Council is also advised by members of the public and by members of the scientific community. Trustee Council, 2009 Report, *supra* note 1, at 7.

9. The other species to share the unenviable title of "not recovering" is the Pigeon Guillemot. *Id.* at 16.

Trustee Council has said it will not deem the Sound's ecosystem recovered unless and until herring abundance has been restored.[10]

As significant as the herring is to the marine food web, relatively little is known about the particular biological mechanisms that caused this fishery to collapse in the wake of the *Exxon Valdez* oil spill. The circumstantial evidence connecting the fishery collapse and the *Exxon* spill, however, is compelling. Before the *Exxon* spill, the herring population was increasing and commercial fishermen were reporting record harvests.[11] In 1993, just four years after the spill, the herring population crashed. That year, only 25 percent of the expected adults returned to spawn.[12] Since then, the Prince William Sound herring fishery has been closed for fifteen of the last twenty years, including every year since 1999.[13] By contrast, in other areas of Alaska that were not hit by the *Exxon Valdez* oil slick (e.g., Sitka), herring populations have not shown abnormal patterns of decline over the last two decades.[14]

After the spill, Exxon was subject to the full litany of civil and criminal fines, penalties, civil litigation, and natural resource damage awards. For instance, as part of the natural resource damage assessment process, Exxon paid $900 million over ten years to the federal and state governments for restoration efforts.[15] In addition, Exxon paid plaintiffs in the *Exxon Valdez* oil spill litigation an estimated $287 million in compensatory damages under the Phase II jury award.[16] Eventually, after several trips to

10. *Exxon Valdez* Oil Spill Trustee Council, Integrated Herring Restoration Program, Draft Outline 3 (Sept. 3, 2008), *available at* http://www.evostc.state.ak.us/Universal/Documents/Publications/IHRP%20-%20Draft%209-3-08.pdf (stating that "[H]erring are an integral part of every inshore ecosystem on the northwest coast of North America and we cannot consider the Prince William Sound ecosystem recovered from the effects of the oil spill until herring abundance has been restored.") [hereinafter Trustee Council, Restoration Program].

11. Evelyn D. Brown & Mark G. Carls, Exxon Valdez Oil Spill Trustee Council Restoration Notebook: Pacific Herring (*Clupea Pallasi*) 3 (Sept. 1998) [hereinafter Trustee Council, Pacific Herring].

12. *Id.*; *see also* Trustee Council, Restoration Program, *supra* note 10, at 3.

13. Trustee Council, Restoration Program, *supra* note 10, at 3.

14. *See* Brief for Jean-Michael Cousteau and Other Natural and Social Scientists as Amici Curiae Supporting Respondents at 22, Exxon Shipping Co. v. Baker, 128 S. Ct. 2605 (2008) (No. 07-219) ("[A]lthough herring populations up to 1989 had been at record highs, and have remained high in other areas of the North Pacific and Gulf of Alaska like unoiled Sitka Sound, herring populations in the oiled areas have remained extremely low ever since 1993.").

15. *See* Agreement and Consent Decree, United States v. Exxon Corp., Nos. A91-082 & A91-083 (D. Alaska Oct. 19, 1991), *available at* http://www.evostc.state.ak.us/Universal/Documents/History/Agree_CD.pdf; Plaintiff Government's Memorandum in Support of Consent Decree, United States v. Exxon Corp., Nos. A91-082 & A91-083 (D. Alaska Oct. 8, 1991), *available at* http://www.evostc.state.ak.us/Universal/Documents/History/GovMemo.pdf. *See generally* William H. Rodgers et al., *The* Exxon Valdez *Reopener: Natural Resources Damage Settlements and Roads Not Taken*, 22 Alaska L. Rev. 135 (2005) (providing additional background on the settlement process).

16. Civil cases filed against Exxon were eventually consolidated into a single action before Judge Russell Holland in the United States District Court for the District of Alaska. Plaintiffs included commercial fishermen, Native Alaskans, and landowners. Plaintiffs were divided into

the Court of Appeals, the Supreme Court upheld a $507.5 million punitive damage award.[17]

Despite the total collapse of the Pacific herring population in Prince William Sound, and despite the full suite of legal remedies lodged against Exxon in the wake of the spill, no meaningful damages were recovered for the disappearance of this critical marine species. The time delay between the spill and the herring fishery collapse in 1993 meant that the jury's award of compensatory damages in 1994 was largely based on the closure of the herring fishery in 1989. Compensation for what would later be revealed as a total collapse of a keystone species was therefore limited to $15.8 million for injury to herring in 1989, and $7 million for 1993.[18] In addition, because the natural resource damage settlement was complete in 1991, the herring population crash was not factored into those damages either. This means that there has been no redress to the fishermen for sustained ecological or economic damage. Any opportunities for such redress based on evolving scientific understanding regarding the relationship between the Exxon spill and the herring fishery collapse is foreclosed.

The story of the Pacific herring in Prince William Sound is illustrative of a broader disconnect between the dynamic, complex, and uncertain nature of ecological injuries on the one hand, and our existing damages paradigm—which requires relatively quick and static opportunities for identification and valuation—on the other hand. Through the herring's story, this article examines the nature of ecological injuries and the shortcomings of our existing damages paradigm for assessing those unique damages.

To address the shortcomings of our existing damages paradigm, this article suggests that we invoke the burden-shifting attributes of the precautionary principle[19] to transfer the risk of long-term, unknown ecological harm to those who have caused the injury. Through such a risk transfer, this article posits that true costs of ecological injury would more properly be borne by actors capable of altering their behavior to avoid such injury in the first place. In addition, this article suggests offering defendants two options

three separate classes for the compensatory damages phase of the trial, but consolidated into a single, mandatory class for the punitive phase. *Exxon Shipping Co.*, 128 S. Ct. at 2613–14.

17. *Id.* at 2634 (vacating $2.5 billion award and upholding $507.5 million); *see also* Baker v. Exxon Mobil Corp. (*In re* Exxon Valdez), 472 F.3d 600, 625 (9th Cir. 2006) (vacating $4.5 billion punitive damage award and remitting to $2.5 billion); *In re* Exxon Valdez, 270 F.3d 1215, 1246–47 (9th Cir. 2001) (vacating $5 billion punitive damages award and remanding to district for consideration in light of *BMW* and *Cooper Industries*).

18. *See In re* Exxon Valdez Litigation, Phase II Jury Verdict (D. Alaska 1994) (on file with author).

19. The precautionary principle generally advocates regulatory action in response to evidence of health and environmental risk, even before harm is manifested or the degree of risk is fully known. *See* David A. Dana, *A Behavioral Economic Defense of the Precautionary Principle*, 97 Nw. U. L. Rev. 1315, 1315 (2003). The precautionary principle often entails shifting the burden of proof to proponents of inaction or those who might harm the environment. *Id.*

for incurring damages for ecological injuries—either accepting a multiplier of the compensatory damage award or paying for later-discovered damages on an ongoing basis through a case-specific superfund. These options are aimed at embodying the total cost of ecological injuries.

Section I of this article describes how the uncertainty and complexity underlying the Pacific herring fishery collapse is characteristic of the unique nature of ecological injuries. Section II examines why our existing damage assessment mechanisms—compensatory damages, punitive damages, and natural resource damages—are insufficient for capturing the extent and duration of ecological harms. Section III examines the history of the precautionary principle, considers the application of that principle in the European Union (EU) and U.S. environmental law, and argues that we should invoke the precautionary principle to create a new framework for assessing damages for ecological harms.

Section I – The Nature of Ecological Injury and the Story of the Pacific Herring Fishery

A. *Uniqueness of Ecological Injuries*

Environmental law scholar Richard J. Lazarus has posited that environmental protection laws have five defining characteristics—complexity, scientific uncertainty, dynamism, precaution, and controversy.[20] These characteristics are reflections of the nature of ecological injuries themselves.[21] Because of their nature, ecological injuries give rise to difficult problems in identifying the extent and duration of harm; proving causal relationships between manifested harm and the allegedly environmentally detrimental act; and providing such identification and proof within the time frame usually required from response plans and redress paradigms.

To most lay people, and certainly to those trained in the field of biology or ecology, it is no secret that the ecological systems forming the world around us are complex and dynamic.[22] After all, ecosystems are living systems that, like the human body, are made up of a series of intricately-woven parts with multiple positive and negative feedback loops. "Even relatively simple ecological systems contain hundreds of different species, each with their own range of susceptibilities to chemicals or other adverse agents or conditions. Moreover, ecological systems are not just a sum of the individid-

20. Richard J. Lazarus, The Making of Environmental Law 16 (2004).

21. *Id.*

22. For a discussion of the complex, dynamic, and uncertain attributes of the environment that, in turn, impact environmental laws, see *id.* at 16–24. *See also* Annecoos Wiersema, *A Train Without Tracks: Rethinking The Place of Law and Goals In Environmental and Natural Resources Law*, 38 Envtl. L. 1239, 1246–48 (2008); Bradley C. Karkkainen, *Collaborative Ecosystem Governance: Scale, Complexity, and Dynamism*, 21 Va. Envtl. L.J. 189, 194–97 (2001).

ual organisms, but have both structural and functional relationships critical to a healthy ecosystem."[23]

Positive and negative response mechanisms duly complicate our understanding of ecosystem dynamics by either amplifying or diminishing the intensity of adverse impacts.[24] There are numerous examples of such mechanisms in the area of climate science. For example, as rising concentrations of greenhouse gases warm Earth's climate, snow and ice begin to melt. This melting reveals darker land and water surfaces that were beneath the snow and ice; these darker surfaces absorb more of the sun's heat, causing more warming, which causes more melting, and so on, in a self-reinforcing cycle. This feedback loop, known as the "ice-albedo feedback," amplifies the initial warming caused by rising levels of greenhouse gases.[25]

In addition, because of the interconnectedness of natural systems, chemicals released into one media will not necessarily manifest their greatest harm in that same media, or in the same location for that matter.[26] Detrimental impacts of acid rain are a good example of this problem. For instance, coal-fired power plants emit sulfur dioxide and nitrogen oxides into the atmosphere.[27] Prevailing winds blow these compounds across state and national borders, sometimes over hundreds of miles.[28] If these compounds are blown into areas where the weather is wet, the acids reacts in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds that fall to the ground in the form of rain or snow.[29] As the acidic water flows over and through the ground, it affects a variety of plants and animals.[30] A compound that began as an air emission in Illinois can

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23. Joanna Burger, *Methods for and Approaches to Evaluating Susceptibility of Ecological Systems to Hazardous Chemicals*, 105 ENVTL. HEALTH PERSP. (Supp. 4) 843, 844 (1997).

24. LAZARUS, *supra* note 20, at 19–21.

25. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT 97 (Susan Solomon et al. eds., 2007) [hereinafter IPCC REPORT]. The effect of cloud cover on climate impacts provides another good example of how these mechanisms complicate our understanding of causal relationships in our global ecosystem. To that end, clouds can amplify global warming by absorbing infrared radiation and thereby exert a greenhouse effect. "A change in almost any aspect of clouds, such as their type, location, water content, cloud altitude, particle size and shape, or lifetimes, affects the degree to which clouds warm or cool the Earth. Some changes amplify warming while others diminish it." *Id.* at 116. Detecting, understanding, and accurately quantifying climate feedbacks have been the focus of a great deal of research by scientists unraveling the complexities of Earth's climate: "Much research is in progress to better understand how clouds change in response to climate warming, and how these changes affect climate through various feedback mechanisms." *Id.*

26. For discussion of how large spatial and temporal dimensions associated with ecological injuries increase the scientific uncertainty in determining the extent of impacts, see LAZARUS, *supra* note 20, at 19–21.

27. *See* NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM, REPORT TO CONGRESS: AN INTEGRATED ASSESSMENT 1–3 (2005).

28. *Id.* at 1.

29. *Id.*

30. *Id.*

find its way into the lakes and streams of the Appalachian Mountains and reap detrimental effects on aquatic life.[31]

Not only do ecological impacts transcend media and space, but individual ecosystem characteristics and the weather patterns at the time of a release will also impact the degree of ecological harm. For example, the *Exxon Valdez* oil spill in Prince William Sound, Alaska, had an even worse effect on that marine ecosystem than did the *Sea Empress* spill between England and Wales, largely because in the former there is little water movement, and the oil remained within Prince William Sound for a longer period of time without dispersing to the ocean where it could be weathered or diluted.[32]

Given the complexity that characterizes ecosystems, predicting the degree of harm that will be caused by an environmental disaster is difficult and transformations to one aspect of an ecosystem often result in unforeseen effects. For example, in the 1960s, public health workers in Borneo sought to control mosquito-borne malaria by spraying village huts with the insecticide DDT. This action set off a chain of events that actually ended up increasing disease in the villages. The chain of reactions went like this: After eating DDT-contaminated food, the local lizard population was devastated. This collapse caused a decrease in the local cat population that relied on the lizards for a primary source of food. The scarcity of cats led to a population explosion of caterpillars and rats. The caterpillars in turn destroyed the thatched roofs and the rats caused increased disease in the villages.[33]

Owing in large part to the complex and dynamic interrelationships that characterize ecosystems, there is a corresponding high level of scientific uncertainty when biologists, ecologists, or other scientists are charged with the task of proving causal relationships or otherwise answering the ever illusive question—why? Providing answers to these questions is made even more difficult given that ecological injuries can occur over long periods of time, sometimes spanning decades or generations. The longer period of time, the greater the number of intervening events, and thus the greater the difficulty in unraveling the cause and effect. This time delay between an ecological disturbance and consequent adverse impacts gives rise to one of the more fundamental, controversial, and complicated questions in environmental law—what level of scientific certainty is enough to compel action or warrant redress?

As Lazarus observes: "When scientists are compelled to give scientific 'answers' within time constraints under which no such answer based in science is possible, they are no longer strictly acting purely as scientists—or at

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31. *Id.*

32. *Id.*

33. *See* LAZARUS, *supra* note 20, at 11.

least they are not acting consistently with the norms of their scientific disciplines."[34] In other words, science—especially when called upon to answer questions of ecological harm—is not the realm of the perfectly explainable or the perfectly predictable. Science can provide some answers, but those answers are not necessarily complete or available at the time that those answers are desired. Choosing to act based on imperfect information is, therefore, a policy issue—a value judgment.[35]

The collapse of the Pacific herring fishery in the wake of the *Exxon Valdez* oil spill is a good illustration of the uncertainty and complexity that plagues our understanding of ecological injuries. In particular, the story of the Pacific herring illustrates how the defining characteristics of ecological injuries create difficulties in (1) ascertaining the precise scientific mechanisms for the damage caused and (2) predicting the long term extent and duration of these injuries. Ultimately, like other ecological injuries, the story of the Pacific herring raises the question of whether we should err on the side of precaution in redressing injuries of this nature.

B. *The Story of the Pacific Herring*

Before the *Exxon* spill, the herring population in Prince William Sound was increasing, with record harvests reported just before the grounding.[36] In fact, in 1989, the biomass of spawning adult herring was estimated at 113,200 metric tons, the largest estimate on record.[37] By 1993, four years after the *Exxon* spill, the herring population crashed with only 25 percent of the expected adults returning to spawn.[38] This meant that the 1989 year class was one of the smallest cohorts of spawning adults recorded.[39] Since then, the Prince William Sound fishery has been closed for fifteen of the last twenty years. It was closed from 1993 to 1996; reopened in 1997 and

34. *Id.* at 21; *see also* Julie B. Bloch, *Preserving Biological Diversity in the United States: The Case for Moving to an Ecosystems Approach to Protect the Nation's Biological Wealth*, 10 PACE ENVTL. L. REV. 175, 180 (1992) (explaining that a biologist "may spend years studying the complex interactions of one or more species within an ecosystem and never quite understand how the system functions as a whole. Unfortunately, actions must be taken in the absence of full knowledge and scientific certainty in order to protect the diverse array of species that are essential to the health of the planet."); Oliver A. Houck, *On the Law of Biodiversity and Ecosystem Management*, 81 MINN. L. REV. 869, 877–78 (1997) ("The science of environmental law is difficult and demanding. Reasonable differences and controversies rage over safe air and water quality levels, the effects of pollutant discharges, and tolerance levels for carcinogens, mutagens, and reproductive toxins.").

35. *See* FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING 8–12 (2004) (offering a "broader and more integrative perspective" on decisions impacting health and the environment rather than the formulaic, cost-benefit approach and urging "precaution in the face of scientific uncertainty and fairness in the treatment of current and future generations").

36. TRUSTEE COUNCIL, RESTORATION PROGRAM, *supra* note 10, at 3.

37. TRUSTEE COUNCIL, PACIFIC HERRING, *supra* note 11, at 3.

38. *Id.*

39. TRUSTEE COUNCIL, PACIFIC HERRING, *supra* note 11, at 4.

1998 based on increasing populations; closed again in 1999 due to declining numbers; and has remained closed ever since.[40]

To understand the impacts of the *Exxon* spill on the herring population in Prince William Sound, one has to understand a little about basic ecology, herring biology, and the timing of the spill relative to herring life stages and behavior.

At all life stages, herring are central to the marine food web.[41] As a forage fish, herring provides a critical biological link between species within the ecosystem.[42] It connects the production of algae and zooplankton to large predators including humpback whales, harbor seals, a large variety of marine and shore birds, bald eagles, jellyfish, other invertebrates, and other fish such as pollock.[43] The reason that herring is such an important link between species is because herring is rich in natural oils containing significant amounts of energy. Through the uptake of herring, the oceanic ecosystem transfers energy between species.[44] The recovery of the Prince William Sound ecosystem post-*Exxon*, therefore, is tied to the recovery of the herring.[45] For example, "seabirds will have difficulty recovering without the recovery of herring, which is a vital food source."[46]

The Pacific herring undergoes four life stages—eggs, larvae, juveniles, and adults.[47] All of these stages are found in the Prince William Sound in various seasons and locations. Spawning in Prince William Sound takes place mainly in April, lasting anywhere from five days to three weeks.[48] Herring spawn along the same beaches every year.[49] During spawning, the eggs attach to eelgrass, rockweed, and kelp in shallow subtidal and intertidal areas.[50] After the eggs hatch (in about May), the larvae migrate to the surface, congregate nearshore, and continue to grow.[51] The larvae are poor swimmers and their distribution is therefore primarily affected by the cur-

40. Trustee Council, Questions, s*upra* note 1, at 35; *see also* TRUSTEE COUNCIL, RESTORATION PROGRAM, *supra* note 10, at 3.

41. BROWN & CARLS, *supra* note 11, at 1. In addition to their ecological importance, herring—namely their eggs—are the foundation of a "multi-million dollar resource that is available to commercial fishers in the spring, before the main salmon seasons open." *Id.* In the early 1900s, herring were dry salted for Asian markets. *Id.* at 3. Until the mid 1960s, herring were sold for fish meal and oil in domestic and international markets. *Id.* Since then, "they have been harvested for their roe and spawn-on-kelp . . . , food . . . , and bait." *Id.*

42. Trustee Council, Questions, s*upra* note 1, at 16.

43. *Id.*

44. *Id.*

45. TRUSTEE COUNCIL, RESTORATION PROGRAM, *supra* note 10, at 3 (*Exxon Valdez* Oil Spill Trustee Council noting that "we cannot consider the Prince William Sound ecosystem recovered from the effects of the oil spill until herring abundance has been restored").

46. Trustee Council, Questions, *supra* note 1, at 15.

47. TRUSTEE COUNCIL, RESTORATION PROGRAM, *supra* note 10, at 6.

48. BROWN & CARLS, *supra* note 11, at 2.

49. *Id.*

50. *Id.*

51. TRUSTEE COUNCIL, RESTORATION PROGRAM, *supra* note 10, at 6.

rents. For the first year or two, nearshore habitats remain important for juveniles.[52] Juveniles then join the adult population in deeper waters. In Prince William Sound, adult Pacific herring rarely spawn before their third year, and the average life span is about nine years.[53] "After spawning in the spring, adult Pacific herring disperse from the spawning aggregations to multiple schools in deeper waters."[54]

As luck would have it, adult herring and their offspring are most vulnerable to predation, weather patterns, ocean conditions, and human activities during the spring—right when the *Exxon Valdez* ran aground.[55] At the same time that 11 million gallons of crude oil were washing up on the beaches and forming a five-hundred-mile oil slick, herring were gathering in the oily nearshore areas of Prince William Sound to spawn. Indeed, "the spill trajectory overlapped the route of adult herring spawning migration and spawning locations, thus creating a significant risk of exposure to adults and eggs."[56]

Because of the timing of the spill and spawning, an estimated 40–50 percent of the egg biomass in 1989 was exposed to oil during early development.[57] In addition, nearly half of the oil that was spilled became beached within Prince William Sound, which is where herring spawn and where juveniles spend the first year or two of their development.[58] Together this created a significant risk of oil exposure to adults and eggs. Unfortunately, but not surprisingly, herring are most sensitive to the toxic effects of oil during the early life stages.[59]

The short-term economic damages from the *Exxon Valdez* oil spill were relatively easy to characterize—"all herring fisheries were closed in 1989 to eliminate the risk of contaminated catches."[60] Similarly, some short-term ecological injuries were discovered through early scientific studies conducted from 1989 to 1991. Those studies concluded that there were substantial sublethal effects in newly hatched larvae including premature hatching, low larval weights, reduced growth, and increased morphologic and genetic abnormalities.[61] There was also reduced survival from hatch to

52. BROWN & CARLS, *supra* note 11, at 2.

53. TRUSTEE COUNCIL, RESTORATION PROGRAM, *supra* note 10, at 6.

54. *Id.*

55. Brown, Norcross, and Short, *supra* note 2, at 2337; Evelyn D. Brown et al., *Injury to the Early Life History Stages of Pacific Herring in Prince William Sound After the* Exxon Valdez *Oil Spill*, *in* PROCEEDINGS OF THE *Exxon Valdez* Oil Spill Symposium, *supra* note 5, at 448, 448.

56. Brown, Norcross & Short, *supra* note 2, at 2337–38; Brown et al., *supra* note 55, at 448–49.

57. Brown et al., *supra* note 55, at 457–58; BROWN & CARLS, *supra* note 11, at 4.

58. Brown, Norcross & Short, *supra* note 2, at 2338 (noting that an estimated 40–45 percent of the oil spilled became beached within Prince William Sound).

59. Brown et al., *supra* note 55, at 449; Brown, Norcross & Short, *supra* note 2, at 2337.

60. BROWN & CARLS, *supra* note 11, at 4.

61. Brown et al., *supra* note 55, at 458; BROWN & CARLS, *supra* note 11, at 5 (summarizing results of early studies); *see also* Richard M. Kocan, Jo Ellen Hose, Evelyn D. Brown & Timothy

free swimming. In particular, egg and larval mortality was twice as great in oiled areas as nonoiled areas.[62] Additionally, juveniles were exposed to oil from the ingestion of copepods, a major food source for young herrings, which accumulate and concentrate petroleum hydrocarbons in their bodies.[63] Adult herring were also exposed to spilled oil; individuals sampled immediately after the spill at oil sites had liver lesions.[64] To be sure, herring were significantly exposed to the toxic oil at all of their life stages—eggs, larvae, juvenile, and adult.[65]

The degree of oil exposure to the herring and the known short-term impacts of exposure would logically suggest that the *Exxon* oil spill in some way caused the herring fishery collapse.[66] In fact, the timing of the early life stages of the herring means that embryos and larvae present in the intertidal area at the time of the spill were exposed to petroleum hydrocarbons and "would be entering the breeding population in 1993 for the first time as 4 year olds."[67] In other words, the herring population crashed in Prince William Sound precisely when the eggs and larvae exposed to oil in 1989 should have been returning to spawn for the first time.

The science connecting the 1989 spill to the 1993 collapse has not been as forthcoming as one might expect.[68] Much of the scientific uncer-

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T. Baker, *Pacific Herring (*Clupea pallasi*) Embryo Sensitivity to Prudhoe Bay Petroleum Hydrocarbons*: *Laboratory Evaluation and In Situ Exposure at Oiled and Unoiled Sites in Prince William Sound*, 53 CAN. J. FISHERIES AQUATIC SCI. 2366, 2373 (1996) ("Naturally spawned herring eggs collected from oil sites in 1989 produced significantly more physically deformed and genetically damaged larvae than did eggs collected from unoiled sites. . . . The results of this study demonstrate that Pacific herring embryos and larvae are adversely affected by exposure to Prudhoe Bay crude oil and responses range from sublethal genetic damage to physical deformities and death.").

62. Michael D. McGurk & Evelyn D. Brown, *Egg-larval Mortality of Pacific Herring in Prince William Sound, Alaska, After the* Exxon Valdez *Oil Spill*, 53 CAN. J. FISHERIES AQUATIC SCI. 2343, 2351 (1996).

63. Brown et al., *supra* note 55, at 449; BROWN & CARLS, *supra* note 11, at 5.

64. BROWN & CARLS, *supra* note 11, at 4.

65. Richard E. Thorne & Gary L. Thomas, *Herring and the "Exxon Valdez" Oil Spill: An Investigation into Historical Data Conflicts*, 65 INT'L COUNCIL EXPLORATION SEA J. MARINE SCI. 44, 48 (2008) ("There are also several indications that both the early and adult life history stages were damaged by the oil spill.").

66. While precise biological pathways and ecological mechanisms were not readily identified to link the spill to the population decline, some scientists nonetheless acknowledged the logical connection between the two events. *See* R.M. Kocan, G.D. Marty, M.S. Okihiro, E.D. Brown & T.T. Baker, *Reproductive Success and Histopathology of Individual Prince William Sound Pacific Herring 3 Years After the* Exxon Valdez *Oil Spill*, 53 CAN. J. FISHERIES AQUATICS SCI. 2388, 2392 (1996) ("It seems unlikely . . . that natural environmental conditions would be more detrimental to aquatic organisms than 11,000,000 gallons . . . of crude oil deposited during the peak of their spawning season.").

67. Kocan, Hose, Brown & Baker, *supra* note 61, at 2367.

68. The impact of the *Exxon* oil spill on herring was not the only aspect of spill impacts that eluded scientists for many years. In fact, in describing the state of recovery twenty years after the spill, Alaska Deputy Attorney General Craig Tillery remarks that the "long-term damage was not expected at the time of the spill and was only just starting to be recognized in 1999, at the 10th Anniversary." TRUSTEE COUNCIL, 2009 REPORT, *supra* note 1, at 2. *See also* Brenda L. Norcross,

tainty surrounding the herring fishery was caused by the fact that the fishery did not collapse until four years after the oil spill. Because of this time delay, the collapse and the oil spill were not initially thought to be linked.[69] Linking the two events was particularly perplexing because there was no known mechanism for continued oil exposure to herring after 1990.[70] Because scientists assumed that harm caused by the spill would have been due to oil exposure immediately after the spill, some believed that the toxic impacts of oil exposure were restricted to the 1989 year class.[71]

It was not until 2007 that a study was published by Richard Thorne and Gary Thomas to support the idea that the herring population in Prince William Sound started decreasing immediately after the *Exxon* spill and was the result of the spill.[72] The reasons for this conclusion were at least twofold. First, recent science suggests that adult herring break the water surface in response to predation, which means that the exposure of adult herring to the surficial *Exxon* oil was greater than originally believed.[73] The exposure of adult herring to the surface oil, therefore, could have caused an even greater number of fish to die from mechanical suffocation.[74] Second, the study found a notable similarity between the pattern of sea lion decline and the herring disappearance between 1989 and 1994. This pattern suggested that the decline of the herring began earlier than 1993.[75]

The scientific uncertainty underlying the Pacific herring collapse is exacerbated by the complex nature of ecological relationships. In particular, the interplay between competition, predation, disease, and climate change make the ability to predict the extent, nature, and duration of harm very difficult. In the case of the herring, there are several theories as to how the *Exxon* spill contributed to the population crash by exacerbating natural pressures.

Take the liver lesions found on the adult herring, for example. While these lesions were originally attributed to oil exposure, subsequent studies

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Jo Ellen Hose, Michele Frandsen & Evelyn D. Brown, *Distribution, Abundance, Morphological Condition, and Cytogenetic Abnormalities of Larval Herring in Prince William Sound, Alaska, Following the Exxon Valdez Oil Spill*, 53 CAN. J. FISHERIES AQUATICS SCI., 2376, 2385 (1996) ("The long-term consequences of the observed effects to the survival of the 1989 year-class cannot be predicted with any certainty, but the magnitude and severity of these effects have prompted further monitoring.").

69. Thorne & Thomas, *supra* note 65, at 44 ("It was generally believed that the 1989 'Exxon Valdez' oil spill did not cause the collapse of the Prince William Sound Pacific herring (*Clupea pallasi*) population because of a 4-year gap between the spill and the collapse.").

70. W.H. Pearson et al., *Why Did the Prince William Sound, Alaska, Pacific Herring (*Clupea pallasi*) Fisheries Collapse in 1993 and 1994? Review of Hypotheses*, 56 CAN. J. FISHERIES AQUATIC. SCI. 711, 711 (1999) ("The low level of oil exposure documented for herring in 1989 and the following years all indicate that the 1989 oil spill did not contribute to the 1993 decline.").

71. *See* Thorne & Thomas, *supra* note 65, at 44.

72. *Id.*

73. *Id.* at 47–48.

74. *Id.* at 48.

75. *Id.* at 46–48.

demonstrated that exposure to the oil from the *Exxon* spill depressed immune functions in herring and allowed expression of viral hemorrhagic septicemia (VHSV).[76] This relationship could explain why herring sampled from Prince William Sound at the time of the fishery collapse in 1993 contained similar lesions even though hydrocarbon exposure was no longer detectable.[77] Once the population levels of herring were depressed as a result of the VHSV and other factors, it is possible that other species have filled some of the ecosystem niches previously occupied by herring.[78] This competition for habitat or food at some life stage may limit the success and ability of herring to recover post-crash.[79] Pollock, for instance, is often found in large numbers in the same habitats as juvenile herring. Pollock have increased in abundance and may keep herring populations at low levels by competing for food and habitat.[80]

Consistent with Lazarus's argument that ecological injuries have a distinctive and unique character, the impacts of the *Exxon Valdez* oil spill on the Pacific herring in Prince William Sound are undoubtedly complex, uncertain, dynamic, and controversial.[81] Time will tell whether the herring collapse is irreversible, but at this point the fishery shows little sign of recovery.

Section II – Limitations of Current Damages Framework in Properly Redressing Ecological Harms

The nature of ecological injuries is, of course, only half of the problem in redressing ecological harms. Our existing tools for remedying harm give rise to the other half of the problem. These tools are not enough for adequately remedying ecological harm. The case of the *Exxon Valdez* oil spill provides a good example of this disconnect. For instance, despite the full suite of legal remedies lodged against Exxon in the wake of the spill, and despite the total collapse of the Pacific herring population in Prince William Sound, the only damages assessed against Exxon for the disappearance of this keystone species were for the closure of the commercial herring fishery in 1989 and 1993. A closer examination of the compensatory damages, punitive damages, and natural resource damages assessed in this case illustrate the flaws in using our current tools for redressing ecological injuries.

76. Brown & Carls, *supra* note 11, at 4; Marty et al., *supra* note 66, at 2390.

77. Brown & Carls, *supra* note 11, at 4.

78. *Id.* at 5–6.

79. *Id.*

80. *Id.* at 6; *see also* Thorne & Thomas, *supra* note 65, at 48.

81. The pacific herring is not the only aspect of the *Exxon* spill that has surprised scientists studying the aftermath of the spill. Indeed, despite initial predictions that the oil washed up on Prince William Sound beaches would not persist beyond ten years later, studies conducted in 2003 have revealed that in some areas the oil released from the *Exxon Valdez* continues to form pools in intertidal zones at levels as toxic as the oil just a few weeks after the spill. *See* Trustee Council, 2009 Report, *supra* note 1, at 10.

A. Compensatory Damages

After much to do in the way of claims processing, case assessment, factual investigation, pre-trial discovery, and motions practice, the jury trial in the *Exxon Valdez* oil spill litigation took place in May 1994. The case was tried in three phases. In Phase I, the issues of liability were litigated, including Captain Hazelwood's intoxication and Exxon's recklessness in putting a known alcoholic in charge of a supertanker. Phase II assessed compensatory damages to commercial fishermen and Alaska Natives. Finally, Phase III considered the issue of punitive damages for the entire class.[82]

During Phase II, both Exxon and the fishermen plaintiffs presented expert testimony regarding impacts to the herring fishery, but the extent of the devastation—e.g., the total collapse of the fishery—was unknown at this time. The time delay meant that the spill's impacts to the ecosystem were far greater than it was possible to discern at the time of the *Exxon Valdez* trial. When the jury awarded damages in Phase II of the trial, therefore, they were largely based on the closure of the herring fishery in 1989. In particular, during Phase II of the civil litigation, the jury awarded plaintiffs $15.8 million for injury to herring in Prince William Sound for 1989, and $7 million for 1993.[83]

The compensation awarded for injury to the Pacific herring fishery was not a failure of advocacy or science. At the time of trial, no one could have predicted the long-term collapse. Our system, however, places the burden of proving harm on the plaintiffs and requires proof in a relatively short post-injury time frame. In addition, the current paradigm provides a one-time chance for proving harm, with no opportunity, short of a creative settlement agreement, to provide damages for injuries discovered at some later date.

Wrapped up in the issue of timing are issues of proof and causation. These issues stem from the unpredictability of the extent and duration of harm. This is not only due to the fact that harms take time to manifest, but also due to the fact that as harms manifest further out from the date of the event, the more difficult it becomes to state with scientific certainty that there is a direct causal connection with the event. In other words, as more time elapses, it becomes even more difficult to explain the causal relationship between the manifested injury and the event. The dynamic nature of the environment combined with this time delay makes the identification of harm especially difficult in a traditional damages paradigm, one that generally provides only a quick and relatively static opportunity for damage as-

82. *In re* Exxon Valdez, 229 F.3d 790, 793 (9th Cir. 2000); *In re* Exxon Valdez, 270 F.3d 1215, 1225 (9th Cir. 2001).

83. *See In re* Exxon Valdez Litigation, Phase II Jury Verdict (D. Alaska 1994) (on file with author).

sessment. The uncertainty and complexity of the injuries operate together to make causation an easy target for defendants.

Ultimately, we need to ask whether the causal doubt generated by the complex and uncertain attributes of ecological injury should be resolved in favor of defendants or plaintiffs. In addition, sometimes the causal connection between an event and harm can be stated with confidence, but the precise ecological mechanisms connecting one event to the other is uncertain.

While compensatory damages are in theory intended to make plaintiffs whole,[84] there are some categories of injury for which traditional compensatory damages are bound to fall short of the mark. Professor Catherine Sharkey, for instance, recognizes that compensatory damages do not capture the total cost of the injury when injuries are "concealed or difficult to detect."[85] This category of cases is consistent with the nature of ecological injuries, whose uncertainty and complexity make detection difficult.[86]

In those cases, where the injurer is more likely to escape liability, additional compensation, beyond what is provided by traditional compensatory damages, may be necessary.[87] Extra-compensatory damages are appropriate to ensure that the injurer is internalizing the full cost of the injury. Achieving internalization of full costs stems from the economic concept of optimal deterrence, in which deterrence results from threatening defendants with "damages equal to the aggregate tortious loss."[88] Scholars have suggested various means of achieving optimal deterrence through extra-compensatory damages, such as creating a separate category of societal compensatory damages[89] or imposing a punitive damages multiplier.[90] Implicit in these proposals is the recognition that compensatory damages cannot by themselves ensure that the total cost of injuries will be recovered.

B. Punitive Damages

Just as compensatory damages alone are unlikely to capture the total cost of ecological injury, neither can punitive damages be relied upon to

84. DOUGLAS LAYCOCK, MODERN AMERICAN REMEDIES 15–16 (2d ed. 1994); *see also* Thomas C. Galligan, Jr., *Disaggregating More-Than-Whole Damages In Personal Injury Law: Deterrence and Punishment*, 71 TENN. L. REV. 117 (2003) (discussing the underlying rationale for compensatory damages and the theory of restitution).

85. Catherine M. Sharkey, *Punitive Damages as Societal Damages*, 113 YALE L.J. 347, 367 (2003).

86. *See supra* Section I.A for a discussion of the nature of ecological injuries.

87. Sharkey, *supra* note 85, at 367.

88. *Id.* at 364 (describing economic theory of optimal deterrence); *id.* at 366 (Sharkey, indeed, explains that to achieve deterrence, "[i]t is essential that the defendant be made to pay damages and that they be equal to the plaintiff's loss.").

89. *Id.* at 389.

90. A. Mitchell Polinsky & Steven Shavell, *Punitive Damages: An Economic Analysis*, 111 HARV. L. REV. 869, 874 (1998) ("When an injurer has a chance of escaping liability, the proper level of total damages to impose on him, if he is found liable, is the harm caused multiplied by the reciprocal of the probability of being found liable.").

ensure that the cost of injury is fully realized and recovered. Indeed, while punitive damages might have been enlisted to fulfill that role a decade ago, due process concerns have increasingly led the United States Supreme Court to curtail the scope of these damages.[91] Even if punitive damages could properly provide additional compensation, they are not a sufficiently reliable mechanism for ensuring that ecological injuries are fully redressed.

At their historical root, punitive damages served the relatively narrow purpose of punishing individual wrongs.[92] Over time, punitive damages evolved to fulfill a range of functions, both retribution and deterrence.[93] To that end, punitive damages became a mechanism for punishing both individual and public wrongs.[94] Law and economics scholars explain that punitive damages fulfill deterrence functions by providing additional compensation to ensure that full cost internalization is achieved.[95] Some states have even gone so far as recognizing that the primary purpose of punitive damages is to compensate for costs not otherwise captured by traditional compensatory damages.[96]

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91. *See* Philip Morris USA v. Williams, 549 U.S. 346 (2007); *see* State Farm Mut. Auto Ins. Co. v. Campbell, 538 U.S. 408 (2003); *see* Cooper Indus., Inc. v. Leatherman Tool Group, Inc., 532 U.S. 424 (2001)*; see* BMW of N. Am., Inc. v. Gore, 517 U.S. 559 (1996); *but cf.* Mark A. Geistfeld, *Punitive Damages, Retribution, and Due Process*, 81 S. CAL. L. REV. 263 (2008) (arguing that "vindictive damages," such as those struck down by the Supreme Court in the wrongful death case of *Philip Morris v. Williams*, can satisfy both substantive and procedural due process).

92. Thomas B. Colby, *Clearing the Smoke from Philip Morris v. Williams: The Past, Present, and Future of Punitive Damages*, 118 YALE L.J. 392 (2008); *see also* Sharkey, *supra* note 85, at 359 (observing that "[t]he prevailing justification for punitive damages is individually oriented, retributive punishment").

93. *See, e.g.*, BMW of N. Am., 517 U.S. at 568 ("Punitive damages may properly be imposed to further a State's legitimate interests in punishing unlawful conduct and deterring its repetition."); Colby, *supra* note 92, at 395 ("The purpose of punitive damages, the Supreme Court has repeatedly told us, is to punish and deter . . . .").

94. Colby, *supra* note 92, at 397 ("In the decades leading up to [Philip Morris v. Williams], punitive damages were, with increasing frequency, awarded to punish the defendant for total harm that its wrongful conduct caused to society, not just the harm that it caused to the actual plaintiff or plaintiffs before the court . . . ."); Sharkey, *supra* note 85, at 351–52 ("[P]unitive damages have been used to pursue not only the goals of retribution and deterrence, but also to accomplish, however crudely, a societal compensation goal: the redress of harms caused by defendants who injure persons beyond the individual plaintiffs in a particular case.").

95. *See, e.g.*, Polinsky & Shavell, *supra* note 90, at 897–98 (developing principles for determining cost internalization damages); Galligan, *supra* note 84, at 128–46 (describing the theory and history of scholarship underlying deterrence function of punitive damages); Thomas C. Galligan, Jr., *The Risks of Reactions to Underdeterrence in Torts*, 70 MO. L. REV. 691, 692 (2008) (arguing that rules for individual actions do not deter effectively in the mass tort context); Ciralo v. City of New York, 216 F.3d 236, 245 (2d Cir. 2000) (Calebresi, J., concurring) (arguing that extracompensatory damages should be available to encourage cost internalization). Some law and economics scholars even argue that the dominant goal of punitive damages should be deterrence. *See* Sharkey, *supra* note 85, at 363 n.44 (citing Dan B. Dobbs, *Ending Punishment in "Punitive" Damages: Deterrence-Measured Remedies*, 40 ALA. L. REV. 831 (1989) (arguing that deterrence is the only legitimate goal of punitive damages)).

96. *See, e.g.*, Michael Rustad & Thomas Koening, *The Historical Continuity of Punitive Damages Awards: Reforming the Tort Reformers*, 42 AM. U.L. REV. 1269, 1321–22 (1993) (citing

Perhaps because punitive damages have taken on an increasing number of roles, the resulting size of punitive awards in some cases has attracted the attention of the United States Supreme Court. Punitive damages have given rise to a rich body of literature[97] and numerous United States Supreme Court decisions.[98] The result of this increased attention has been an effort to scale back the size of extravagant awards by refocusing punitive damages on its core purposes. Indeed, after recent Supreme Court decisions in *Philip Morris v. Williams* and *Exxon v. Baker*, the historical conception that punitive damages could serve as a supplement to individual compensatory damages is "all-but-discredited."[99] In *Williams*, the Court clarified that punitive damages cannot be used to compensate for harms to nonparties.[100] In *Exxon*, though technically a decision rooted in federal maritime law, the Court reiterated that "[t]he consensus today is that punitive damages are aimed not at compensation but principally at retribution and deterring harmful conduct."[101] While there may have been a time in the history of punitive damages jurisprudence when such damages were thought to provide additional compensation to fill gaps otherwise left by compensatory damages, that

Connecticut and Michigan as examples of jurisdictions that viewed punitive damages as serving, at least in part, a compensatory function in the 1990s).

97. *See, e.g.*, *supra* note 95 for examples of scholarship relating to the deterrence function of punitive damages.

98. *See supra* note 91; *see also* Honda Motor Co. v. Oberg, 512 U.S. 415 (1994); TXO Prod. Corp. v. Alliance Res. Corp., 509 U.S. 443 (1993); *cf.* Ciraolo, 216 F.3d at 236.

99. Sharkey, *supra* note 85, at 390; *see also* Colby, *supra* note 92, at 400 (noting that Philip Morris USA v. Williams, 549 U.S. 346 (2007), "put an end to the uncertainty" that punitive damages might appropriately be used to compensate for harm to nonparties, e.g., for public wrongs); *see also* Michael P. Allen, *Of Remedy, Juries, and State Regulation of Punitive Damages: The Significance of Philip Morris v. Williams*, 63 N.Y.U. ANN. SURV. AM. L. 343, 365 (2008) (suggesting that Williams rejected a traditional deterrence rationale for punitive damages, upholding only a retributive one); Dan Markel, *How Should Punitive Damages Work?*, 157 U. PA. L. REV. 1383, 1407 ("On account of the Supreme Court's recent decision in *Philip Morris*, proponents of the cost internalization approach now face substantial difficulties. . . . By restricting the permissible scope of harm for punitive damages, the Philip Morris decision now raises questions about whether 'total cost internalization' is forbidden.").

100. *Philip Morris*, 549 U.S. at 356–57 ("We did not previously hold explicitly that a jury may not punish for the harm caused others. But we do so hold now."); *see also* State Farm Automobile Ins. Co. v. Campbell, 538 U.S. 408, 423 (2003) (remarking that a "defendant should be punished for the conduct that harmed the plaintiff, not for being an unsavory individual or business. Due process does not permit courts, in calculation of punitive damages, to adjudicate the merits of other parties' hypothetical claims against a defendant.").

101. Exxon Shipping Co v. Baker, 128 S. Ct. 2605, 2621 (2008); *see also* Barnes v. Gorman, 536 U.S. 181, 189 (2002) (reiterating that "punitive damages are not compensatory"). Several of the amicus briefs submitted to the Supreme Court on behalf of commercial fishermen in *Exxon v. Baker* argued that a larger punitive damage award was justified on the basis of uncompensated harms. One of the uncompensated harms cited in those arguments were the damages to the Pacific herring fishery that were unknown at the time of trial. *See* Amicus Brief of Jean-Michel Cousteau and Other Natural and Social Scientists, Exxon Shipping Co. v. Baker (No. 07-219) at 3–4 (arguing that "Exxon has not paid for the full impact of the destruction it has caused in the oil spill region" and arguing that punitive damages are necessary to where the monetary value of noneconomic harm might have been difficult to detect."); *id.* at 20–22 (describing long-term consequences to herring that have gone uncompensated).

time is past. Punitive damages are no longer an appropriate tool for redressing uncompensated or undercompensated ecological harms.

Even if punitive damages were a viable option for addressing nonretributive compensatory damages, the history of the *Exxon Valdez* litigation shows that punitive damages are not a reliable tool for capturing undercompensated harms.[102] Fourteen years elapsed from the time the jury handed down a $5 billion punitive damages award in 1994 to the time the Supreme Court diminished that award to $507 million in 2008. In between, numerous appeals and remands struggled with the appropriate level of punitive damages based on newly evolving Supreme Court decisions.

A brief overview of the history of punitive damages appeals in the Exxon litigation might bring this point home. In 1997, Exxon first appealed the punitive damage award to the Ninth Circuit Court of Appeals. The Ninth Circuit upheld the assessment of punitive damages against Exxon but found the award of $5 billion in punitive damages excessive in light of *BMW of North America v. Gore*.[103] The Ninth Circuit remanded the case for reconsideration in light of the *BMW v. Gore* guideposts.[104] On remand, Judge Holland reexamined the punitive damages award and reduced it to $4 billion.[105] Exxon again appealed to the Ninth Circuit, this time arguing that the punitive damage award was excessive in light of *State Farm v. Campbell*.[106] The Ninth Circuit again concluded that a punitive damages award of $4 billion was not permissible under the Fifth Amendment Due Process Clause and remanded the case for reconsideration in light of *State Farm v. Campbell*.[107] In 2004, Judge Holland reconsidered the amount of the punitive damages award in *Baker* and increased the award to $4.5 billion.[108] In 2006, after hearing the case for the punitive damages issue for the third time, the Ninth Circuit reduced the punitive damages award to $2.5 billion based on Fifth Amendment Due Process Clause standards.[109] After granting Exxon's petition for certiorari, the Supreme Court ultimately reduced the punitive damage award to $507 million from its original $5 billion, con-

102. Simply relying on punitive damages to cover the cost of injuries missed by traditional compensatory damages is unreliable and imprecise, conflating the purpose of various types of damages. *See* Markel, *supra* note 99, at 1387 (suggesting that for clarity, punitive damages should be broken into three kinds of extracompensatory damages, including retributive, deterrence, and aggravated damages); *id.* at 1403 n.64 (discussing other scholars who have suggested disaggregating the multiple functions of punitive damages); *see also* Sharkey, *supra* note 85, at 356 ("There are few givens when it comes to the centuries-old, highly controversial doctrine of punitive damages."). Rather than force punitive damages to shoulder a number of varied purposes, the different purposes of punitive damages should be carved out and addressed separately. Galligan, *supra* note 84, at 128 ("Disaggregation and separation will lead to clarity.").

103. *In re* Exxon Valdez, 270 F.3d 1215, 1246 (9th Cir. 2001).

104. *Id.* at 1246–47.

105. *In re* Exxon Valdez, 236 F. Supp. 2d 1043, 1068 (D. Alaska 2002).

106. *In re* Exxon Valdez, 472 F.3d 600, 611–12 (9th Cir. 2006).

107. *Id.*

108. *In re* Exxon Valdez, 296 F. Supp. 2d 1071 (D. Alaska 2004).

109. *In re* Exxon Valdez, 472 F.3d at 602.

cluding that the case could only support a 1:1 ratio of compensatory to punitive damages.[110]

Fourteen years from verdict to resolution. Numerous appeals and remands. Two intervening Supreme Court decisions on punitive damages. As it happened, the jury's punitive damage award in 1994 was not bound for closure any time soon and the outcome of the award was surely unpredictable. Indeed, by the time the Supreme Court decided the *Exxon* case in 2008, 20 percent of the 32,000 plaintiffs were deceased. Punitive damages were certainly not a predictable or reliable tool for ensuring total cost recovery and deterrence in the *Exxon* litigation.

C. Natural Resource Damages

On their face, natural resource damages appear to be the most promising candidate for redressing ecological harms. After all, the articulated purpose of natural resource damages is the full assessment of natural resource injuries such that these resources can be restored to the extent feasible. However, natural resource damages are limited in several respects that make them an underutilized tool in redressing environmental injuries.

First, federal natural resource damages are limited principally to releases under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)[111] and the Oil Pollution Act (OPA).[112] This means that natural resource damages are options only when there has been a release of oil into navigable waters or a hazardous substance release into the environment.[113] In addition, under CERCLA and OPA, natural resource damages may only be pursued by designated federal, state, or tribal trustees who act on behalf of the public interest.[114]

110. Exxon Shipping Co. v. Baker, 128 S. Ct. 2605, 2634 (2008).

111. 42 U.S.C. §§ 9607–9675 (2009).

112. 33 U.S.C. §§ 2701–2761 (2009). OPA was enacted in response to the *Exxon Valdez* oil spill. *See* William H. Rodgers, Jr. et al., *The Exxon Valdez Reopener: Natural Resource Damage Settlements and Roads Not Taken*, 22 ALAS. L. REV. 135 (2005). The Clean Water Act (CWA) also contains provisions providing for natural resource damages when oil and hazardous substances are released to navigable waters. 33 U.S.C. § 1321(f)(5) (2009).

113. CERCLA and OPA create liability for injury to, destruction of, or loss of natural resources. 42 U.S.C. § 9607(a)(4)(C); 33 U.S.C. § 2702(b)(2)(A). The statutes similarly define natural resources as "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 . . ., any State or local government or Indian tribe, or any foreign government . . . " 33 U.S.C. § 2701(20); *see also* 42 U.S.C. § 9601(16) (2009). CERCLA creates liability for the release of hazardous substances into the environment and OPA creates liability for the discharge of oil into navigable waters, adjoining shorelines, or the exclusive economic zone of deep ocean waters. Note also, that while CERCLA and OPA do not limit states from imposing additional liability requirements or creating additional rights of action, state natural resource damage programs vary widely in their effectiveness. If a uniform and reliable framework for redressing ecological injuries is what we seek, successful state natural resource damage programs could inform the issue but not resolve it.

114. 33 U.S.C. § 2706(b)(1); 42 U.S.C. § 9607(f)(1). This means that private plaintiffs seeking to recover damages for injuries caused by harm to the environment—e.g., the private land-

Even if federal natural resource damages were more widely available in theory, natural resource damages have proven to be underutilized tools for recovering ecological injuries because of the costs and controversy associated with assessing and valuing natural resource injuries. This is the second major limitation of natural resource damages. In order to support a claim for natural resource damages, for instance, trustees typically prepare a natural resource damage assessment. While not mandated by regulation, a natural resource damages assessment is a key component of proving the extent of damages to which trustees are entitled. To that end, CERCLA creates a rebuttable presumption in favor of damages assessed according to regulatory procedures.[115] Without that presumption, the trustees face the unenviable task of proving that a particular person caused the harms identified in the natural resource damage claim and that the costs of those harms are properly valued. As a practical matter, therefore, natural resource damage assessments are indispensable for trustees seeking to avoid challenge and costly litigation by potentially responsible parties.

Natural resource damage assessments, however, are costly propositions.[116] In fact, the prospect of undertaking the cost of an assessment puts pursuit of natural resource damages out of reach for some state and federal trustees.[117] While polluters are ultimately responsible for reimbursing the trustees for the cost of the assessment for successful claims, the time and expense for conducting such an assessment is more than the budgets of many trustees can bear in the first instance.[118]

owners or commercial fishermen plaintiffs in the Exxon litigation—could not unilaterally avail themselves of CERCLA or OPA's natural resource damage provisions. Local governments and private parties would have to resort to relief provided under state or common law, if any. 42 U.S.C. § 9652(d) (CERCLA does not modify remedies available under the common law).

115. 42 U.S.C. § 9607(f)(2)(c).

116. New Mexico v. Gen. Elec. Co., 467 F.3d 1223, 1242 n.28 (10th Cir. 2006) (noting that the court is "well aware that NRD assessment is a costly proposition"). In *New Mexico v. General Electric*, the Tenth Circuit went on to explain that "[a]ccording to two commentators, after its 1986 amendments, CERCLA 'cast trustees adrift to finance their own damage assessment before filing claims against polluters—a costly proposition, given that damage assessments typically cost millions of dollars. This lack of funding has created a virtually insurmountable obstacle considering that agency budgets have historically authorized little or no funding for NRD assessments.'" *Id.* (quoting Gina M. Lambert & Anthony R. Chase, *Remedying CERCLA's Natural Resource Damages Provision: Incorporation of the Public Trust Doctrine Into Natural Resource Damage Actions*, 11 VA. ENVTL. L. J. 353, 371–72 (1992)).

117. Patrick E. Tolan, Jr., *Natural Resource Damages Under CERCLA: Failures, Lessons Learned, and Alternatives*, 38 N.M. L. REV. 409, 447–48 (2008) ("Natural resource trustees are generally understaffed and underfunded.").

118. *Id.* Some states, like New Jersey and California, have devised relatively successful natural resource damage programs because they have made funding available for damage assessments up front. *Id.* at 438–44 (discussing New Jersey approach to natural resource damages). In addition, these states have also been successful at reducing the cost of assessments by enacting regulations that approve certain simplified methodologies. *Id.* Those simplified methodologies, however, are nonetheless vulnerable to legal challenge absent any presumption in favor of the trustee if methodologies are followed. *See id.* at 445.

As concluded by a federal advisory committee report released in 2007, the federal natural resource damages process needs to be revised in order to make restoration of natural resources "faster, more efficient, and more effective."[119] To that end, the advisory committee's recommendations were aimed, in part, at establishing cooperative relationships with potentially responsible parties in order to: (1) encourage responsible parties to fund damage assessments in the first instance; and (2) avoid valuation issues by encouraging responsible parties to conduct the restoration activities.[120] Until natural resource damage processes and methodologies can be revised to facilitate effective recovery of public costs to natural resources, they will most likely continue to be underutilized and met with success in only the unusual case.

Where does the Exxon natural resource damages settlement fit into this picture? In many ways, the Exxon settlement is an example of a best-case scenario—a success story in the world of natural resource damages. First, though the extent of the *Exxon Valdez* oil spill was unprecedented, the impacts of oil on the marine environment are relatively well-studied when compared to the release of hazardous substances and toxic cocktails that typically define Superfund sites under CERCLA. As a result, in relative

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119. NATURAL RESOURCE DAMAGE ASSESSMENT & RESTORATION FEDERAL ADVISORY COMMITTEE, FINAL REPORT 7 (2007), *available at* http://restoration.doi.gov/pdf/facamtg5finalreport.pdf [hereinafter 2007 FAC Report]. *See also* Tolan, *supra* note 117 (arguing for revision of federal natural resource damages program); James Peck, Comment, *Measuring Justice for Nature: Issues in Evaluating and Litigating Natural Resources Damages*, 14 J. LAND USE & ENVTL. LAW 275 (1999) (arguing for revisions to natural resources damages regulations); Dale B. Thompson, *Valuing the Environment: Courts' Struggles with Natural Resources Damages*, 32 ENVTL. L. 57 (2002).

120. *See* 2007 FAC REPORT, *supra* note 119. On this latter point, one of the most hotly contested issues in natural resource damage claims is valuation. *See, e.g.*, Allan Kanner and Tibor Nagy, *Measuring Loss of Use Damages in Natural Resource Damage Actions*, 30 COLUM. J. ENVTL. L. 417, 448 (2005) (noting that "measuring natural resource damages is 'the most daunting task facing trustees.' ") (citing Richard Stewart et al., *Evaluating the Present Natural Resource Damages Regime: The Lawyer's Perspective*, *in* NATURAL RESOURCE DAMAGES: A LEGAL, ECONOMIC, AND POLICY ANALYSIS 163 (Richard Stewart ed., 1995); James L. Nicoll, *Environmental Restoration: Challenges for the New Millennium: The Irrationality of Economic Rationality in the Restoration of Natural Resources*, 42 ARIZ. L. REV. 463, 464 (2000) (challenging traditional economic theory in the valuation of natural resources); Thompson, *supra* note 119, at 60 ("Natural resource damages present a significant challenge for the legal system because in most cases they are non-market commodities,"). How do we effectively measure the loss of, or injury to, certain resources? One approach is by measuring the use and existence value of the resource from a utilitarian perspective, e.g., the worth of the resource measured by its value to individuals or society. *See* Peck, *supra* note 120, at 279–82. Another approach—the biocentric approach—would measure the intrinsic value of the resource independent of human satisfactions. *Id.* Not surprisingly, the preferred method of valuing natural resources is to quantify utilitarian values of use and existence through some method of cost-benefit analysis. *Id.* Three of the most common methods for measuring the value of natural resource damages are market valuation, restoration and replacement cost, and contingent valuation. *Id.* Regardless of the chosen method, however, there are certain to be controversies given that natural resource damages are unique in many instances and their uses not readily subject to valuation.

terms, the trustees were in a better position to assess natural resource damages for the *Exxon* spill.[121]

Second, the natural resource trustees avoided litigation of their natural resource damages claim by settling the claims with Exxon for $900 million, to be paid over ten years.[122] That settlement was signed in 1991, just two years after the spill, allowing the damages recovered to be put to quick use in restoring the Prince William Sound marine ecosystem and studying the lingering impacts of the spill. Indeed, because of the controversies surrounding natural resource assessment and valuation, the most successful strategy for pursuing natural resource damage claims appears to be cooperative arrangements with the potentially responsible parties and settlement.[123]

By contrast, in cases where natural resource damages are litigated, the resolution can be many years in the making and the outcome not always favorable to the trustees. For example, in 1999 the state of New Mexico filed a claim for natural resource damages in federal district court in a case involving the release of hazardous substances in groundwater.[124] After three years of motion practice, the case was scheduled for a pretrial conference in 2002.[125] The district court reached a decision on the merits in 2004[126] and the Tenth Circuit Court of Appeals issued a final decision in 2006.[127] After seven years of litigation, New Mexico walked away empty handed, unable to prove its claim for damages.[128]

In addition to settlement, the *Exxon* case benefited from coordination and agreement among trustees. In some cases, no such agreement is forthcoming. For example,

121. *See* Tolan, *supra* note 117, at 425–26 (noting that "there are over 100,000 industrial chemicals that are on the market today, presenting scientists with unprecedented challenges in defining aggregate and cumulative impacts on the environment and her creatures"); *id.* at 426 ("unlike oil spills under OPA and point source discharges under the Clean Water Act, other types of discharges are more challenging to assess."). That said, it is important to remember that the ability to predict long-term impacts of oil spills may be better than the ability to predict injuries resulting from some hazardous substance releases, but that does not mean our ability to predict the impacts of *Exxon* were perfect, or even good. *See* Rodgers, *supra* note 112, at 153 (quoting National Research Council study from 2003 that concluded "[o]ne of the more profound outcomes of the 1989 Exxon Valdez oil spill was the recognition of our limited ability to realistically predict the effects of an oil spill on marine resources").

122. Agreement and Consent Decree, para. 6, 8, United States v. Exxon Corp., No. A-91-081 (D. Alaska Oct. 9, 1991) [hereinafter 1991 Consent Decree].

123. Tolan, *supra* note 117, at 447–49 (describing the benefits of cooperative relationships verses litigation); *see also* 2007 FAC REPORT, *supra* note 119, at 10 (describing cooperation as providing a "great potential to leverage success and result in more effective, efficient, and sustainable natural resources restoration and protection.").

124. For an in-depth, case-study discussion regarding the New Mexico litigation, see Tolan, *supra* note 117, at 426.

125. *Id.*

126. *See* New Mexico v. Gen. Elec. Co. (Gen. Elec. I), 335 F. Supp. 2d 1157 (D.N.M. 2003); New Mexico v. Gen. Elec. Co. (Gen. Elec. II), 335 F. Supp. 2d 1185, 1231 (D.N.M. 2004).

127. New Mexico v. Gen. Elec. Co. (Gen. Elec. III), 467 F.3d 1223 (10th Cir. 2006).

128. *Id.*

> [a]fter the lower Fox River had been contaminated by polychlorinated biphenyls (PCBs) from local paper companies, the Wisconsin Department of Natural Resources (DNR) settled the case for seven million dollars at a time when the U.S. Fish and Wildlife Service (FWS) estimated natural resource damages to be between $176 million and $333 million.[129]

In the Fox River case, the state and federal trustees did not even agree on the scope of the damage itself.

Finally, the federal and state trustees successfully negotiated for the inclusion of a reopener provision in the settlement agreement. That reopener provision allowed the trustees to seek an additional $100 million for restoration projects in Prince William Sound and other areas affected by the oil spill.[130] The provision set a window for claiming additional damages—September 1, 2002 to September 1, 2006.[131] In addition, the trustees were required to show that the injury for which they claimed additional damages "could not reasonably have been known nor could it reasonably have been anticipated" by any trustee as of the date of the 1991 settlement.[132] By including the reopener provision, trustees were able to address some of the inherent difficulties in valuing ecological injuries—namely the uncertainty pertaining to long-term impacts.

Even though the *Exxon* natural resource damages settlement might be deemed a success story on the whole, it nonetheless highlights the limitations in the ability to capture all costs. First, though oil spills are relatively well-studied when compared to CERCLA's toxic slurries, the long-term impacts of the spill were, and to some extent still are, unpredictable.[133] Indeed, at the time of the settlement in 1991, much was unknown about the impacts of the *Exxon* oil spill. "The 1991 settlement was thus approved despite a measure of ignorance."[134]

Second, settlement is not always the mark of a successful natural resource damage claim resolution. To that end, if settlement is being pursued by the federal or state trustees because a trustee-funded natural resource damages assessment is prohibitively expensive and the notion of natural resource damages litigation too costly and protracted, the liable party gains leverage in the settlement negotiations. In other words, the liable party would appear to be in the position of power, despite facing sizeable natural resource damages, because the trustee may need the responsible party to cooperate in order to effectively pursue natural resource damages at all. In

129. Tolan, *supra* note 117, at 431–32.

130. 1991 Consent Decree para. 17.

131. *Id.*

132. *Id.*

133. *See supra* Section I for a discussion of unknown impacts to Pacific herring. *See also supra* notes 8 and 62 for a description of long-term impacts.

134. *See* Rodgers, *supra* note 112, at 153; *see also supra* note 8, for a discussion of scientists' evolving understanding of impacts from the *Exxon* oil spill.

those situations, the amount of natural resource damages ultimately negotiated may be well below the actual cost of the injuries imposed by the liable party on the environment.[135]

Third, though the $900 million natural resource damage claim was considered a record natural resource damage settlement at the time,[136] those funds have not ensured the full restoration of the Prince William Sound ecosystem. In June 2006, the federal and state trustees requested an additional $92 million under the reopener provision to fund restoration projects based on the continued presence of oil in the habitats of Prince William Sound beaches.[137]

Despite the promise of the reopener provision for capturing adverse impacts unknown at the time of settlement, it is still unclear whether the reopener provision will achieve its intended purpose. Notably, this was the first time that the U.S. Department of Justice had ever submitted a demand under a reopener provision.[138] Moreover, the reopener demand does not request funds in connection with the long-term damage to the herring fishery.[139] Of course, such funding was not part of the original settlement award given that the collapse of the fishery had not even occurred at that time. In addition, whether the reopener will achieve its intended purpose is still unclear. Despite a wealth of science to the contrary, Exxon appears to contest the fact that there is lingering oil in Prince William Sound. Exxon's investigation appears to be ongoing.[140] So even though the trustees successfully negotiated the inclusion of a reopener provision, it remains to be seen whether Exxon will be held accountable for the lingering impacts of the spill. This again illustrates that there are bound to be controversies stemming from the identification and valuation of ecological injuries despite the best laid plans.

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135. Given that contingent valuation studies done on the damage to Prince William Sound ranged from $3 billion to $15 billion, *see* Rodgers, *supra* note 112, at 149, it is possible that the $900 million settlement underestimated the value of the damages. On the other hand, at the time that the trustees were negotiating the *Exxon* natural resource damage settlement, "there were no functional rules for calculating [natural resource damages]" and "no one, not even federal litigators, had confidence in the [$3 billion to $15 billion] estimates." *Id.* at 149. "The lack of a complete, accurate damages valuation suggests the political nature of the settlement." *Id.* at 153.

136. *See* Press Release, Dep't of Justice, Exxon to Pay Record One Billion Dollars in Criminal Fines and Civil Damages in Connection with Alaskan Oil Spill (Mar. 13, 1991).

137. *See* Joint Press Release, Dep't of Justice and State of Alaska Dep't of Law, United States and the State of Alaska Seeking Additional Funds from ExxonMobil for Continuing Natural Resource Damages Caused By 1989 Oil Spill (June 1, 2006), *available at* http://www.evostc.state.ak.us/Files.cfm?doc=/Store/Event_Documents/SAK-DOI_PressRelease.pdf&.

138. *See* U.S. FISH & WILDLIFE SERIVCE, EXXON VALDEZ OIL SPILL – CIVIL SETTLEMENT "REOPENER" 2 (2006), http://www.pwsrcac.org/docs/d0025800.pdf.

139. *See* Comprehensive Plan for Habitat Restoration Projects Pursuant to Reopener for Unknown Injury, http://www.fakr.noaa.gov/oil/.

140. The Alaska Department of Law's Environmental Section notes on its website that the reopener demand letter was submitted on August 31, 2006 and that "the governments continue to pursue this matter." *See* About Alaska's Department of Law's Environmental Section, http://www.law.state.ak.us/department/civil/enviro.html#exxon.

The *Exxon* natural resource damages settlement, therefore, highlights that under other scenarios—where a slurry of hazardous substances are at issue, where no successful settlement is reached, or where there is little cooperation between federal and state trustees—natural resource damages would not necessarily be an effective means of recovering costs in a timely and reliable manner. Under these less than ideal circumstances, the identification and valuation issues that plague all ecological injuries would be even less likely to be redressed by natural resource damages.

All this is to demonstrate that natural resource damages are not a ready-made solution to redressing ecological harms. Though their theoretical purpose might come closest to capturing the total cost of ecological injury, these damages do not provide a widely accessible or applicable method for assessing and recovering the costs of environmental injury. Indeed, natural resource damages suffer from some of the same fundamental problems as compensatory damages—there is inherent difficulty and uncertainty in identifying and valuing ecological harms. Rather than natural resource damages being a ready-made tool for ensuring full cost recovery for ecological harms, it is worth considering whether the natural resource damages framework might benefit from some of the proposals in this article to aid with more efficient identification and valuation of harm, and encouragement of settlements to avoid lengthy and costly litigation. That issue is, of course, for another day.

Section III – Invoking the Precautionary Principles to Find a Workable Solution

I submit that the failure to pinpoint the precise ecological pathways through which the *Exxon* oil spill impacted the herring fishery is not a failure of science. I further submit that the failure to redress this injury through the *Exxon Valdez* litigation or natural resource damage assessment process is not a failure of advocacy. Rather, I propose that the nature of the ecological injuries makes it very difficult in cases like this to identify the extent and duration of the harm within our existing legal framework. As illustrated by the *Exxon* case, our current legal tools for compensating ecological harms are insufficient at: (1) identifying the ecological harm over a meaningful timeframe; and (2) valuing those harms to reflect their unique, public nature.

In light of these difficulties, I propose that we consider a special damages paradigm for addressing ecological injuries. In particular, I propose that we invoke the precautionary principle to shift the risk wrapped up in the uncertain, complex, and irreversible nature of ecological injuries.

A. Background on Precautionary Principle

In its traditional application, the precautionary principle encourages government entities to adopt cost-effective measures to control environmental risks even in the face of scientific uncertainty.[141] Some argue that the spirit of the precautionary principle has been acted upon for many decades, if not centuries.[142] Articulation of the precautionary principle as such, however, did not emerge until the late in the twentieth century in Germany. To that end, the principle is thought to have its roots in the German concept of *Vorsorgeprinzip*, loosely translated as "foresightplanning."[143] As explained by the German Federal Interior Ministry in 1984, "[t]he principle of precaution commands that the damages done to the natural world (which surrounds us all) should be avoided in advance and in accordance with opportunity and possibility. . . . [I]t also means acting when conclusively ascertained understanding by science is not yet available."[144]

Since its emergence, this principle has been expressly endorsed by the EU as part of its regulatory directives. Indeed, the 1997 Treaty establishing the EU declared that its environmental policy "shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay."[145] In February 2000, the European Commission issued a communication detailing how the principle should be applied in the EU's environmental policy decisions.[146] In the course of its analysis, the Commission concludes that the principle has "become a full-fledged and general principle of international law."[147] One example of the principle's application is in the burden of proof required by some EU rules. The Commission explains that for some products like drugs, pesticides, or food additives, regulations make the producer or manufacturer responsible

141. *See* Dana, *supra* note 19, at 1315–16.

142. Robert V. Percival, *Who's Afraid of the Precautionary Principle?*, 23 PACE ENVTL. L. REV. 21, 23 (2006) (providing history of precautionary principle and noting that "some have argued that the precautionary principle is thousands of years old because millennial oral traditions of indigenous people contain the concept of precaution."); *see also* ACKERMAN & HEINZERLING, *supra* note 35, at 17–20 (describing the principle and arguing for its broader adoption in the adoption of U.S. environmental laws).

143. Percival, *supra* note 142, at 23–24.

144. *Id.*

145. *Id.* at 26 (citing Treaty of Amsterdam Amending the Treaty on European Union, the Treaties Establishing the European Communities and Certain Related Acts—Consolidated Version of the Treaty Establishing the European Union, art. 174(2), 1997 O.J. (C 340)).

146. *Commission of the European Communities, Communication From the Commission on the Precautionary Principle* 1 (Feb. 2000), *available at* http://ec.europa.eu/dgs/health_consumer/library/pub/pub07_en.pdf.

147. *Id.* at 21.

for proving that the substance is not hazardous before it can be placed on the market.[148]

The most public international display of support for the principle occurred at the 1992 Earth Summit in Rio de Janeiro.[149] The Rio Declaration, adopted by the United National Conference on Environment and Development during the Summit, states that: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[150] The Rio Declaration was signed by representatives of 178 nations, including the first President Bush. This statement of the precautionary principle has also been embraced in subsequent international agreements.[151]

A similarly descriptive explanation of the precautionary principle was offered in a consensus statement by a group of environmental scientists:

> Scientific studies can tell us something about the costs, risks, and benefits of the proposed action, but there will always be value judgments that require political decisions. . . . Although there are some situations in which risks clearly exceed benefits no matter whose values are being considered, there is usually a large gray area in which science alone cannot (and should not) be used to decide policy. . . . When there is substantial scientific uncertainty about the risks and benefits of a proposed activity, policy decisions should be made in a way that errs on the side of caution with respect to the environment and the health of the public.[152]

The precautionary principle, at its root, openly acknowledges the scientific uncertainty that is inherent in predictions of environmental impacts. No scientist can say with complete confidence that certain consequences will or will not flow from the many footprints humans leave in the sands of the Earth. Rather than use that uncertainty as an excuse to do nothing, however, the precautionary principle provides a value-based reason for pursuing sensible actions despite uncertainty.

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148. *Id.*

149. *Id.*

150. Percival, *supra* note 142, at 25 (quoting U.N. Conference on Environment & Development (UNCED), June 3–14, 1992, *Rio Declaration on Environment and Development*, Principle 15, U.N. Doc. A/CONF.151/26 (Aug. 12, 1992).

151. Percival, *supra* note 142, at 25.

152. ACKERMAN & HEINZERLING, *supra* note 35, at 118 (citing David Kriebel et al., *The Precautionary Principle in Environmental Science*, ENVTL. HEALTH PERSP., Sept. 2001, at 873, 875).

B. Principle in Action in U.S. Environmental Law

Looking to the precautionary principle for guidance in redressing ecological injuries is not a radical notion. The United States already incorporates the spirit of this principle into many aspects of environmental law.[153]

The Clean Air Act, for example, requires the Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards to protect the public health with an adequate margin of safety.[154] The Clean Air Act also requires the EPA to regulate fuel additives that "may reasonably be anticipated to endanger the public health or welfare."[155] This is different from the Act's original language that required regulation only for additives that "will endanger the public health or welfare."[156] Congress amended the language after lead-additive manufacturers challenged the EPA's decision to control lead-additives in gasoline. Sitting en banc, the United States Court of Appeals for the D.C. Circuit upheld the EPA's decision despite the "will endanger" language of the Act.[157] In a landmark decision, the court recognized the precautionary nature of the Clean Air Act and concluded that "[r]egulatory action may be taken before the threatened harm occurs; indeed the very existence of . . . precautionary legislation would seem to demand that regulatory action precede, and, optimally, prevent, the perceived threat."[158]

In a similarly precautionary spirit, the Clean Water Act (CWA) requires states to identify all water bodies that fail to meet water quality standards despite effluent limitations contained in permits. For these identified water bodies, states must determine the total maximum daily load of pollutants that would allow attainment of water quality standards. In setting this

153. "[E]ven without expressly embracing the precautionary principle, U.S. environmental law has developed in a manner quite consistent with many elements of it. . . ." Percival, *supra* note 142, at 36; Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 U. PA. L. REV. 1003, 1005–07 (2003) (explaining that "[i]n the United States, without using the term explicitly, Congress has built a notion of precaution into some important statutes, allowing or requiring regulation on the basis of conservation assumptions."); *see also* Lazarus, *supra* note 20, at 23 (noting that the irreversible nature of much ecological injury drives environmental law to reflect a precautionary principle and to focus, accordingly, on preventing the realization of environmental risks rather than the redressing of environmental harms).

154. 42 U.S.C. § 7409(b)(1) (2002).

155. Clean Air Act Amendments of 1977, Pub. L. No. 95-95, § 401(e), 91 Stat. 685 (1977) (codified at 42 U.S.C. § 7545(c)(1)(A)).

156. Clean Air Act Amendment of 1970, Pub. L. 91-604, § 211(c)(1)(A), 84 Stat. 1676 (1970) (codified as amended at 42 U.S.C. § 7545(c)(1)(A)).

157. Ethyl Corp. v. EPA, 541 F.2d 1 (D.C. Cir. 1976).

158. *Id.* at 13. For a detailed description of the history of events underlying the lead-additive controversy, see Percival, *supra* note 142, at 57–63. Percival also provides other excellent examples of how the precautionary principle is embedded in U.S. environmental lawmaking. *See also* ACKERMAN & HEINZERLING, *supra* note 35, at 4 (describing the leaded gasoline controversy and calling the D.C. Circuit decision "a landmark" "because it established that EPA could act in a precautionary fashion rather than wait for scientific certainty about the harmfulness of a substance before acting.").

maximum load, the CWA requires the states to include "a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality."[159]

Also, the environmental review process set forth in the National Environmental Policy Act (NEPA)[160] is based on the premise that federal agencies should look before they leap. NEPA requires federal agencies to prepare detailed environmental impact statements assessing potential impacts of major actions.[161] Agencies must consider the alternatives to their proposed actions.[162] And while NEPA does not dictate the outcome of agency decision making,[163] the precautionary principle is inherent in the idea that agencies carefully consider the consequences of their actions before making "any irreversible and irretrievable commitment of resources."[164]

There are other times in the history of U.S. environmental lawmaking that protective measures have been adopted before the scientific evidence of harm could be fully formulated. The U.S. regulatory policy to phase out chloroflurocarbons (CFCs) is a good example. The EPA promulgated regulations in 1978 to limit the use of CFCs in nonessential aerosol propellants. At the time, scientific research confirmed that CFCs could in theory be damaging the ozone layer, but there was still no definitive proof. The EPA's response came nearly a decade before the international community would sign the Montreal Protocol on Substances that Deplete the Ozone Layer.[165]

To be fair, the precautionary principle has its critics, usually from economics and law scholars advocating a cost-benefit analysis.[166] For example,

159. Clean Water Act, 33 U.S.C. § 1313(d) (2006).

160. 42 U.S.C. § 4321–4347 (2006).

161. 42 U.S.C. § 4332(C) (2006). Notably, the U.S. Environmental Protection Agency describes NEPA as inserting environmental values into its decision-making: "[NEPA] federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions." *See* U.S. Environmental Protection Agency, National Environmental Policy Act (2009), http://www.epa.gov/Compliance/nepa/index.html.

162. 42 U.S.C. § 4332(C)(iii) (2006).

163. *See* Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 351 (1989) ("NEPA merely prohibits uninformed—rather than unwise—agency action.").

164. 42 U.S.C. § 4332(C)(v) (2006); *see also* Metcalf v. Daley, 214 F.3d 1135, 1143 (9th Cir. 2000) (noting that "agencies must prepare NEPA documents, such as EA or EIS, before any irreversible or irretrievable commitment of resources").

165. The Montreal Protocol called for a freeze on the consumption and production of CFCs at 1986 levels and a 50 percent reduction in CFC use by industrialized countries over a ten-year period. *See* Percival, *supra* note 142, at 63 (citing RICHARD ELLIOT BENEDICK, OZONE DIPLOMACY: NEW DIRECTIONS IN SAFEGUARDING THE PLANET 87 (1991)).

166. *See, e.g.*, Sunstein, *supra* note 153, at 1020–22 (arguing that the precautionary principle is "paralyzing" because it offers no real guidance on when activities should be regulated and to what degree). *But see* Dana, *supra* note 19, at 1330–32 (critiquing critics of the precautionary principle and making the affirmative case for its usefulness in mitigating cognitive biases in decisionmaking); Percival, *supra* note 142, at 27–29 (discussing criticisms of precautionary principle).

Professor Cass Sunstein criticizes the precautionary principle for being "paralyzing" and "unhelpful."[167] Sunstein explains that the precautionary principle often appears to call for more stringent regulation in the face of uncertainty.[168] But more stringent regulations, he argues, will in some cases eliminate "opportunity benefits" or carry other "substitute risks."[169] For instance, setting a fifty parts per billion standard for arsenic in drinking water could result in over one hundred deaths per year in the worst case scenario.[170] While the precautionary principle would counsel for more stringent regulation, Sunstein explains that a ten parts per billion standard would "cost over two hundred million dollars each year" and "save as few as five lives annually."[171] The cost of the arsenic regulation could lead people to switch to private wells, which have high levels of contamination.[172] Sunstein uses this example (and others) to conclude that the precautionary principle does not provide ready guidance to whether more stringent regulation is appropriate because more stringent regulation is not without its own costs.[173]

The criticisms leveled by Sunstein, even if accepted at face value, do not resonate when the precautionary principle is invoked in the manner suggested here. This article suggests using the precautionary principle in the context of assessing ecological damages, to transfer costs associated with the uncertainties of ecological harm unto the party responsible for that harm. While there may be substitute risks or missed opportunities caused by shifting costs to the liable party, asking the liable party to bear the cost of those risks or missed opportunities is not the same as balancing between one set of costs to public health and another (as described in Sunstein's arsenic example above). Instead, invoking the precautionary principle here is a conscious decision that requiring liable parties to bear the risks associated with ecological harm is preferable to asking the injured party, society, or the environment to do so. Scholars critical of the trend toward narrow economic analysis of health and environmental protection, such as economist Frank Ackerman and law professor Lisa Heinzerling, have explained:

> When the question is to allow one person to hurt another, or destroy a natural resource; when a life or landscape cannot be replaced; when harms stretch out over decades or generations; when outcomes are uncertain; when risks are shared or resources are used in common; when people 'buying' harms have no relationship with the people actually harmed—then we are in the realm of

167. Sunstein, *supra* note 153, at 1004, 1008.
168. *Id.* at 1022–23.
169. *Id.* at 1023–25.
170. *Id.* at 1020–21.
171. *Id.* at 1021.
172. *Id.* at 1025.
173. Sunstein, *supra* note 153, at 1025.

> the priceless, where market values tell us little about the social values at stake.[174]

Ackerman and Heinzerling, therefore, "urge precaution in the face of scientific uncertainty."[175] Even Sunstein recognizes that "for risks for which there are no satisfactory basis for balancing costs and benefits, such as catastrophic risks or risks of species extinction, something akin to the precautionary principle makes good sense."[176] The case of requiring liable parties to bear the cost of uncertainties associated with ecological damages, as suggested below, appears to be a situation where there is no satisfactory basis for balancing costs and benefits, or elevating private gain over public interest.

C. Applying the Precautionary Principle to Damages for Ecological Injuries

Often the irreversible nature of the ecological injuries drives the adoption of a precautionary approach to prevent the risk of harms in the first instance.[177] While our environmental laws seem to invoke the spirit of the precautionary principle at the front-end of environmental regulation, we do not seek guidance from this principle at the *back-end*—namely when harm has occurred and we are determining the proper redress. Rather, as illustrated by the *Exxon* case, our existing damages paradigm has difficulty accounting for the uncertainty and complexity of ecological injuries.

That is why I propose using the precautionary principle to develop a burden-shifting framework, whereby in the face of uncertainty concerning the extent and duration of ecological injuries, the liable party bears the costs and risks that accompany that uncertainty. Though in its traditional application the precautionary principle operates to encourage regulation despite uncertainties, this proposal would draw on the aspect of the principle that shifts the burden of proof to the liable party, similar to the EU regulations described earlier.

More specifically, I propose that a defendant determined to be liable for environmental injuries is offered two options for damages. As a first option, the defendant may choose to accept a multiplier for compensatory damages to account for the uncertainty of the harm caused. As a second option, the defendant may choose to pay damages as they are assessed on an ongoing basis into the future.[178] I will consider the benefits and drawbacks for each of these options in turn.

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174. ACKERMAN & HEINZERLING, *supra* note 35, at 8–9.

175. *Id.* at 11.

176. Percival, *supra* note 142, at 58 (citing Sunstein, *supra* note 153, at 16).

177. *See* LAZARUS, *supra* note 20, at 23.

178. The reason for allowing defendants to choose one option or the other is to avoid issues of finality and judicial economy by forcing the defendant to pay for damages on an ongoing basis into the future. Such finality concerns often arise in the context of criminal law. *See* Daniel S.

The purpose of the multiplier is to address the difficulties in identifying the full extent of ecological harm that may have been caused by the defendant's conduct. Due to their uncertain and complex nature, there is a high likelihood that ecological injuries are more extensive than initial investigation will reveal. The multiplier mitigates identification issues by working a margin of safety into the compensatory scheme. The benefit of the multiplier is that it gives defendants an opportunity for relatively quick resolution. The tradeoff is its admittedly rough-cut nature. In other words, the aim of the multiplier is to offset some of the inherent uncertainties in valuing ecological harm, but the result is not necessarily a precise measure of the total cost. By imposing a multiplier, however, the defendant is forced to internalize the uncertainties of its actions by operating within a damages framework that accounts for some of the unique qualities of ecological harm.[179]

The multiplier concept is not a new one. Compensatory damage multipliers are, for example, authorized in the area of antitrust law. Federal antitrust and RICO statutes provide for treble damages.[180] "Theoretically, treble damages may be justified on the basis that all wrongs of the relevant type will not be detected and prosecuted; therefore, trebling awards will provide a more realistic measure of all the damages that the wrongdoer has caused and will force that wrongdoer to pay (or face) them."[181] Some law scholars have argued for a multiplier approach in punitive damages in order to facilitate optimal deterrence.[182] While deterrence would not necessarily be the

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Medwed, *Up the River Without a Procedure: Innocent Prisoners and Newly Discovered Non-DNA Evidence in State Courts*, 47 ARIZ. L. REV. 655, 691 (2005) ("Among the benefits of finality offered by backers of time limits are gaining peace of mind, avoiding disturbing settled expectations, and reducing uncertainty and costs associated with uncertainty."); *see also id.* at 688, n.221 ("noting that the Supreme Court has consistently proclaimed that 'finality is essential to both the retributive and deterrence functions of the criminal law and to the interests of victims of crimes in obtaining closure'" (citing Seth F. Kreimer & David Rudovsky, *Double Helix, Double Bind: Factual Innocence and Postconviction DNA Testing*, 151 U. PA. L. REV. 547, 606 (2002))).

179. For a detailed discussion of the benefits of augmented awards, see Galligan, *supra* note 84, at 129 (Galligan explains that "[t]he gist of Augmented Awards was that actual recoveries in tort suits, for example, for any number of reasons, might not accurately or adequately represent the actual value of the injuries or losses caused by the behavior . . . . According to the hypothesis in Augmented Awards, in any case where the compensatory damages awarded (plus other applicable sanctions or costs) are less than the full accident costs of the activity, an augmented award to those who recover might lead to optimal deterrence and efficient behavior.").

180. *See* 15 U.S.C. § 15(a) (2006); 18 U.S.C. § 1964(c) (2006).

181. Galligan, *supra* note 84, at 121.

182. *See* Polinsky & Shavell, *supra* note 90, at 897–98 ("If a defendant can sometimes escape liability for the harm for which he is responsible, the proper magnitude of damages is harm the defendant has caused, multiplied by a factor reflecting the probability of his escaping liability."); *see also* Ciraolo v. City of New York, 216 F.3d 236, 245 (2d Cir. 2000) (Calabresi, J., concurring) ("Such a [multiplier] conception of punitive damages, again, is not new, and it has been recognized by courts as well as scholars."); Sharkey, *supra* note 85, at 372 n.71 (collecting cases in which courts have expressed approval for a multiplier approach in punitive damages); *see also* Anthony Sebok, *Deterrence or Disgorgement?: Reading Ciraolo After Campbell*, 64 MD. L. REV. 541 (2005) (discussing other areas where multipliers have been proposed). *But see* Sharkey, *supra*

driving factor in implementing a multiplier for costs of ecological injuries, increasing the likelihood that liable parties would internalize the full cost of those injuries would nonetheless have that effect.

Because a multiplier provides a simple, if crude, basis for assessing compensatory damages for ecological injuries, a defendant might prefer to assess and value the ecological injuries on an ongoing basis in order to avoid possible overcompensation. The benefit of providing this second option is that it gives defendants some control over their own fate, lessening their ability to argue that the multiplier treats them unfairly or forces overcompensation. If a defendant believes that the extent of ecological injuries caused by its actions were fairly and fully identified at the time of trial, the defendant is free to stand by that belief and agree to pay for additional harms that might manifest later.

The benefit of this option to plaintiffs is that it allows time for the full extent of ecological injuries to manifest. In the case of Exxon, for example, the collapse of the Pacific herring fishery did not even occur until after the compensatory and punitive damages were determined at trial. Whether the complete panoply of injuries would become apparent and therefore compensated would depend on the length of time that defendants were required to pay for damages. For Exxon, for example, scientists continue to discover lingering impacts of the spill even twenty years after its occurrence.[183] One obvious question that would have to be resolved, therefore, is: how long is long enough for requiring ongoing assessment and payment for injuries?

In practice, this option would obviously require a greater level of third-party management and oversight than a simple multiplier. Such oversight could be accomplished by assigning a special master to the case. In order to ensure that a defendant does not become insolvent, a defendant might be required to place some multiple of compensatory damages in escrow at the time that liability was determined. The special master could then approve expenditures from this case-specific "superfund" as future damages are established by the plaintiff.

The drawback of offering defendants the option to pay into the future would be the costs of oversight, and the potential for ongoing litigation regarding the scope of damages caused by the defendant. In other words, while this option would in theory result in damages that are more likely to reflect actual cost of harm, the nature of ecological injuries is such that

note 85, at 369–70 (suggesting that the Supreme Court in *State Farm v. Campbell* "cast doubt upon use of a strict punitive damages multiplier").

183. Using data from the *Exxon Valdez* oil spill, social scientists Steven Picou, Brent Marshall, and Duane Gill concluded that "litigation serves as a source of chronic stress for victims of human caused disasters involved in court deliberations for damages." Steven J. Picou, Brent K. Marshall, and Duane A. Gill, *Disaster, Litigation, and the Corrosive Community*, SOCIAL FORCES, June 2004, at 1493–1522. This research raises the question of whether offering defendants an option to pay damages into the future on an ongoing basis would actually cause plaintiffs to suffer greater harm.

establishing harm becomes more difficult as more time has elapsed and delay would provide a defendant the opportunity to avoid payment through battle-of-the-expert challenges.

Under either option, some criteria for determining when this special damages framework should apply would have to be developed. Rather than tie these damages to reprehensibility as in the punitive context, I propose returning to the characteristics that Richard Lazarus proposes make ecological injuries unique in the first place. In particular, in the spirit of the precautionary principle, I propose that this special damages framework should be the default *unless* the defendant can show that the traditional characteristics of ecological injuries do not apply. To that end, the framework would not apply if the defendant could show that (1) the injury is one whose extent and duration is accompanied by a high level of predictability, (2) the injury is not irreversible (i.e. there are proven techniques for treatment or restoration), *and* (3) there is an insignificant amount of controversy over the underlying science.

It is also worth considering whether different categories of environmental harm could benefit from different multipliers to accommodate the uncertainty, complexity, hazards, and irreversibility. Through the use of several different multipliers, loosely tailored to various activities, the damages regime would create varying levels of deterrence or risk-changing behavior for activities that create more significant hazards.

In the end, the multiplier option and the option of paying damages on an ongoing basis have advantages and disadvantages. Of course, the devil is in the details in terms of setting particular multipliers, negotiating the duration of a future payment arrangement, and developing a set of criteria for determining when such a special damages framework should apply. The first step to achieving a system that properly compensates for ecological injuries, however, is to recognize the uniqueness of those injuries, accept that there will be imperfections in the identification and valuation of harm, and make a commitment to shifting the burden of uncertainty on the defendants whose actions, regardless of motive, put the environment and public resources at risk.

IV. Conclusion – Making a Value Judgment

In the end, the types of special damages that I suggest in this article respond to the uniqueness of ecological injuries. By invoking the precautionary principle—namely by incorporating a margin of safety into the compensation and by placing the burden on defendants to show the framework should not apply—I fully acknowledge that society would be making a value judgment. By that I mean that the nature of ecological harms is such that society will rarely, if ever, be able to completely and fairly value those harms. Our system will almost always end up under-compensating or over-compensating. Given the choice, I argue that the public and often irreversible nature of these harms require that the system errs on the side of overcompensation.[184] This is the value judgment. Given the choice of placing the risk of uncertain injuries on the defendant or plaintiff, the precautionary principle provides a guide to putting the risk and the ensuing costs on the defendant, the actor in the best position to manage inevitable risks and avoid unnecessary ones.

184. *See also* Sharkey, *supra* note 85, at 442–43 (discussing the concept of societal compensatory damages in the context of the *Exxon Valdez* oil spill and noting that it would be useful for certain types of torts to ask why "our greater concern is with underdeterrence rather than overdeterrence").