Hubris and Humility in Environmental Law

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"There's an idea going about that the human race basically understands how the universe works. Not you and me, obviously, but scientists perhaps, or experts. Regrettably, this is not the case."

— John Lloyd[1]

"Arrogance diminishes wisdom."

— Arabian Proverb

I. Introduction

Once upon a time, a long, long time ago, bloodletting by lancet and leeches reigned as the remedy of choice for many a medical malady.[2] Likewise, closed windows and no bathing seemed like sensible solutions for treating the bubonic plague.[3] In hindsight, these approaches appear unsound, hardly therapeutic, and even ludicrous. People make mistakes, often big ones—a point of no great surprise to most of us.

Bloodletting, the withdrawal of blood from a patient to cure or prevent illnesses, was a popular medical practice for some 2500–3000 years, beginning with the ancient Egyptians and continuing until the late 19th century, when it fell into disfavor.[4] Practitioners of bloodletting often used lancets coupled with suction to draw blood from their patients' limbs, or leeches—worms with suckers at each end—to suck the blood from their patients' lips, gums, nose, and fingers.[5] Although bloodletting conceivably, albeit inadvertently, may have had a beneficial effect by temporarily reducing blood pressure, after 1830 criticism mounted from the medical, homeopathic, and botanist communities, and the practice "gradually declined until, by the end of the century, it had all but disappeared."[6] As Dr. Oliver Wendell Holmes, father of Supreme Court Justice Oliver Wendell Holmes Jr., once said of bloodletting: "[t]he lancet was the magician's wand of the dark ages of medicine."[7]

The medieval medical profession's no-bathing prescription for bubonic plague victims fared little better.[8] According to historian Norman Cantor, "[t]he Black Death of 1348–49 was the greatest biomedical disaster in European and possibly in world history."[9] Expanding beyond Europe, the Black Death of the fourteenth century "devastated nations and caused populations to vanish" in Western Europe, the Mediterranean world, and beyond.[10] Medieval physicians concluded that the bubonic plague was "spread through the air—as a miasma—from person to person," rather than by a deadly bacillus parasite carried by fleas on the backs of rats.[11] As a consequence, medieval physicians encouraged people to close and cover their windows (to keep out the bad air) and discouraged bathing (to avoid opening the pores to invasion).[12] These measures triggered a sudden demand for

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1. John Lloyd & John Mitchinson, The Book of General Ignorance: Everything You Think You Know Is Wrong, at xix (2006).
2. *See* Gilbert R. Seigworth, *Bloodletting Over the Centuries, in Red Gold: The Epic Story of Blood*, Public Broadcasting Service (2002), http://www.pbs.org/wnet/redgold/basics/bloodlettinghistory.html.
3. *See* Norman F. Cantor, In the Wake of the Plague: The Black Death and the World it Made 22–23 (2001).
4. *See* Seigworth, *supra* note 2; *see also* Audrey Davis & Toby Appel, Bloodletting Instruments in the National Museum of History and Technology 1 (1979), *available at* http://www.sil.si.edu/smith soniancontributions/HistoryTechnology/sc_Browse.cfm?by=title_normalized ("Bloodletting, the removal of blood from the body, has been practiced in some form by almost all societies and cultures.").
5. *See* Seigworth, *supra* note 2. After sponging one of these areas with milk and/or sugar (to encourage attachment), the leech would be placed against the patient's skin. Typically, the leeches let go when engorged with the patient's blood. To obtain more blood than a leech could physically contain, texts advised practitioners to cut their tails off to prolong the blood sucking. Along with instrument selection, the location of the drawing was also important. Davis & Appel, *supra* note 4, at 1, 5 (discussing use of lancets and leeches and noting controversy over location of the bloodletting). Davis and Appel describe one authority on bloodletting recommending that "bleeding be done from a blood vessel on the same side of the body as the disease. For example, removal of blood from the right elbow to stop a nosebleed from the right nostril" whereas another recommending a site nearest the disease. Davis & Appel, *supra* note 4, at 5.
6. Davis & Appel, *supra* note 4, at 15–16.
7. *See* Seigworth, *supra* note 2.
8. *See* Cantor, *supra* note 3, at 23.
9. Cantor, *supra* note 3, at 6. Note that Cantor uses the term "Black Death" to refer to the massive elimination of much of Western Europe's population by bubonic plague (or by bubonic plague in combination with other causes). *See id*. at 7, 11, 16–17.
10. *See* Cantor, *supra* note 3, at 6–7.
11. *Id*. at 21.
12. *Id*. at 22–23.

large and elaborate tapestries for window coverings and elicited a notorious "pungent no-bath era," but they most likely did little to thwart the plague.[13]

With respect to bloodletting and the bubonic plague, it turns out that what so many confidently *knew* to be right turned out to be stunningly wrong. The same may be said about environmental remedies. What we think we know about the environment may be wrong, and if so, it may lead us off course despite our best intentions and efforts to manage, restore, conserve, and protect it. This may be particularly true with respect to some of the toughest environmental challenges of our day, including the confounding problem of global climate change[14] and such controversial issues as genetically engineered foods.[15] Arrogance in judgment can and indeed has led to environmental harm, if only by postponing genuine solutions. Given these unavoidable truths, a more prudent approach would be to regulate[16] with less environmental hubris and greater environmental humility.

Part II of this Article sets out several historic examples of regulatory hubris in environmental problem solving—situations where human arrogance played a starring role in bringing about less than salubrious environmental results. The examples aim to illustrate situations where—despite good intentions—conceit and overconfidence of those charged with shaping and implementing environmental protections led to devastating environmental harm. Deliberately excluded from the discussion are examples where self-serving behavior factored most heavily in devastating environmental consequences.[17] In Part II and throughout this Article, the term *regulatory hubris* refers to sheer human arrogance, conceit, and unjustified certitude in governmental decisionmaking. The objective is to bring attention to a component of regulatory dysfunction—regulatory hubris—as distinct from other regulatory failures. Part III of the Article examines various explanations for this tendency toward overconfident approaches. Part IV argues for integrating greater humility in environmental problem solving and offering some specific suggestions for fostering more humble regulatory decisionmaking. The Article concludes in Part V.

II. Environmental Mistakes of Historic Proportions

A. *A Deadly Love Affair: The Promise and Peril of Pesticides*

The history of U.S. pesticide regulation exemplifies the deep hole that imperious environmental decisionmaking can dig. In particular, the saga of dichlorodiphenyltrichloroethane ("DDT")[18] illustrates the considerable peril of regulatory hubris. First touted as a "miracle"[19] chemical for all things pest-related and seemingly a product even better than sliced bread,[20] the blessing of DDT turned out to be a mischaracterization of woeful proportions.[21] DDT not only put a hasty end to many a pesky pest, but also nearly caused the extinction of our national symbol, the bald eagle, as well as that awesome creature the peregrine falcon, and quite a few other less charismatic but not insignificant terrestrial and marine species.[22] And, while DDT reduced crop losses from insect infestation, pesticide-assisted agriculture may ultimately prove less profitable over time than pesticide-free agriculture.[23] There is little doubt that DDT greatly reduced suffering and deaths from insect-borne disease around the world;[24] however, these benefits came with unrecognized, unsavory long-term costs,[25] including growing pesticide resistance,

13. *Id.* at 21–23. Additional counter measures included strict human quarantines (although human to human transmission now appears to have been low risk) and urban flight (an option primarily for the rich). *Id.* at 21, 25.
14. *See* Robin Kundis Craig, "*Stationarity is Dead*" *– Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 Harv. Env. L. Rev. 9, 38 (2010) ("Human industrialization may have set climate change in motion, but the planet's systems are responding in way that we do not fully understand and at spatial and temporal scales that far exceed the scope of existing regulatory mechanisms.").
15. *See* Timothy Egan, *Frankenfish Phobia*, N.Y. Times, Mar. 17, 2011, http://opinionator.blogs.nytimes.com/ 2011/03/17/frankenfish-phobia/.
16. In using the term "regulate" throughout this Article I mean to include legislative as well as administrative policy actions. Similarly, I intend the term "regulation" to be understood expansively, conveying the sense of both administrative and legislative programs, policies, and directives.
17. A number of recent environmental disasters offer examples of this excluded category of regulatory dysfunction. Examples include the 2010 Massey Energy coal mine explosion and the BP oil spill in the Gulf of Mexico, where it can be argued that regulator tacit acceptance of the prioritizing of corporate profits over environmental preparedness resulted in lost lives and environmental catastrophe. *See* Bob Herbert, Op-Ed, *More Than Just an Oil Spill,* N.Y. Times, May 2, 2010, http://www.nytimes.com/2010/05/22/opinion/22herbert.html; Anne C. Mulkern & Patrick Reis, *After W.Va. Mine Deaths, How Much Political Trouble Is Coal Industry In?*, N.Y. Times, Apr. 9, 2010, http://www.nytimes.com/gwire/2010/04/09/09greenwire-after-wva-mine-deaths-how-much-political-troub-43969.html; Campbell Robertson et al., *Oil Hits Home, Spreading Arc of Frustration,* N.Y. Times, May 24, 2010, http://www.nytimes.com/2010/05/25/science/earth/25spill.html; David M. Uhlmann, Op-Ed, *Prosecuting Crimes Against the Earth*, N.Y. Times, June 4, 2010, http://www.nytimes.com/2010/06/04/opinion/04uhlmann.html ("The Justice Department's case against BP will be strengthened by the company's history of criminal violations, which offer evidence of a culture that puts profits before the environment and worker safety.").
18. DDT is a poison that kills insects by over-stimulating their nervous system. John Wargo, Our Children's Toxic Legacy: How Science and Law Fail to Protect Us from Pesticides 37–38 (1996) ("[Insects said to get] 'the DDT's,' suffer from a combination of twitching and convulsions followed quickly by coma and death.").
19. *See* William H. Rodgers, Jr., *The Persistent Problem of the Persistent Pesticides: A Lesson in Environmental Law*, 70 Colum. L. Rev. 567, 574 (1970) (DDT's "reputation was established quickly as a miracle insecticide, effective in controlling the carriers of many dreaded tropical diseases, including malaria, typhus and yellow fever"); Andrew P. Morriss & Roger E. Meiners, *Property Rights, Pesticides, & Public Health: Explaining the Paradox of Modern Pesticide Policy*, 14 Fordham Envtl. L.J. 7 (2002) (DDT's discovery "hailed as a modern miracle"); *see also* Wargo, *supra* note 18, at ix.
20. In 1953, Senator Allen Ellender optimistically contended that the new insecticides would both bolster national security and help defeat communism. *See* Morriss & Meiners, *supra* note 19, at 8.
21. Government officials are not the only ones capable of policy errors. An arrogant opposition, focused solely on demonizing DDT and touting nothing less than wholesale rejection of the pesticide's use, may have added unnecessarily to human suffering abroad. *See id.* at 40.
22. *See, e.g.,* Holly Doremus, *Constitutive Law and Environmental Policy*, 22 Stan. Envtl. L.J. 295, 303 (2003) ("DDT caused precipitous declines in the populations of raptors and other sensitive birds.").
23. *See* Wargo, *supra* note 18, at 6–7 (discussing a National Academy of Science study finding that over the long-term, pesticide-free farms may be more profitable).
24. *See id.* at 13, 42 (DDT has probably saved millions of lives, especially in tropical areas).
25. *See* Doremus, *supra* note 22, at 303 ("[T]hirty years after DDT use was banned in the United States, deposits in sediments remain a threat to some bird populations.").

reductions in human reproductive capacity, and increased incidence of cancer.

Although first synthesized in 1874, DDT's insecticidal effects did not come to light until 1939.[26] The love affair with DDT took hold soon thereafter. DDT seemed the ideal cheap date: easy to use, persistent, versatile, less toxic, and low cost.[27] DDT even won top beauty pageant honors: a Nobel Prize for its insecticidal attributes.[28] During DDT's "honeymoon" period,[29] the U.S. government encouraged production and use, first for military purposes during World War II and then on the home front. During the war, "[a]s soon as the potential effectiveness of DDT was recognized, government stimulated production and designed new technologies to facilitate its broadscale application. Bombers were retrofitted with tanks and spraying devices invented to quickly blanket the landscape with insecticides."[30] Following the war, "[m]ilitary expertise, equipment, and DDT stockpiles were quickly redirected toward insect-borne disease control and crop protection."[31] In just one domestic battle against gypsy-moths in New York State, the U.S. Department of Agriculture ("USDA") mixed DDT with fuel oil, hired tanker planes, and blanketed one million acres with the mixture.[32] New York authorities contributed by spraying over three million acres, including suburban lots, tree-lined streets, and commuter train stations.[33] Ignorant of the peril, "[o]n hot summer afternoons, children would run behind the spray trucks, cooling themselves and frolicking in the toxic mists."[34]

In the United States, DDT production, export, and use reached as high as 188 million pounds in a single season.[35] Prior to banning, domestic use of DDT reached in the range of 1.35 billion pounds.[36] Thus, the public's enamor with DDT was such that we bathed, slept,[37] commuted, romped, and even wedded[38] in it.

Congress and federal agencies acted irresponsibly with respect to pesticides. While many factors likely contributed—strong lobbying by powerful special interests, scientific uncertainty, agency capture, complacency, and incompetence—regulator hubris exacerbated the harm and delayed appropriate corrective action. Despite evidence of DDT's risks at hand, government agencies, primarily USDA, actively promoted widespread DDT application[39] during the late 1940s and throughout most of the 1950s.[40] In response to growing public concerns, rather than turn down the DDT spigot, USDA instead offered pesticides for free to encourage continued use.[41] Even after publication of Rachel Carson's *Silent Spring*,[42] USDA persisted in supporting widespread application. At congressional hearings in the 1960s, Orville L. Freeman, Secretary of Agriculture, aggressively reiterated the benefits and defended the continued use of pesticides, including DDT, as an economic necessity and a matter of national public health, and was lavishly praised by members of Congress for doing so.[43] Not until August of 1970, after not less than four government committee reports recommending the phasing out of DDT,[44] did USDA finally ban DDT for most domestic uses.[45]

Although the government's role in the DDT saga may be fairly portrayed as incompetent,[46] it is overly simplistic to posit that the bureaucrats were all bumbling idiots. At the same time, neither is this merely a case of government putting the agricultural chemical and pesticide industry in charge of the environment and public health. Many agency employees believed themselves to be acting in the public interest by attempting to reduce the spread of disease, aid farmers, and save forests.[47] Despite the agency employees' good intentions, however, authorized use of DDT persisted for decades after the case was made for stricter regulation and more controlled use. The primary reasons for DDT's longevity was the regulators' (1) stubborn allegiance to new technology rooted in

26. Envtl. Prot. Agency, EPA-541/1-75-022, DDT: A Review of Scientific and Economic Aspects of the Decision to Ban Its Use as a Pesticide 251 (1975) (Prepared for the Committee on Appropriations of the U.S. House of Representatives) [hereinafter EPA DDT REVIEW]; *see also* Wargo, *supra* note 18, at 37 (Othmar Zeidler synthesized DDT at University of Strasbourg in 1874).
27. *See* EPA DDT REVIEW, *supra* note 26, at 251 (early "popularity of DDT . . . due to its reasonable cost, effectiveness, persistence, and versatility"); Rodgers, Jr., *supra* note 19, at 574 (DDT's "cheapness, low toxicity of the applicator, broad spectrum effect, and persistence combined to produce what was thought to be an ideal general purpose insecticide).
28. *See* Rodgers, Jr., *supra* note 19, at 574.
29. *See* Morriss & Meiners, *supra* note 19, at 1 (describing four distinct pesticide DDT periods: the pre-modern era, the honeymoon, the rise in conflict, and the ban).
30. Wargo, *supra* note 18, at 40.
31. *Id.* at 43.
32. *See id.* at 142.
33. *Id.*
34. *Id.*
35. Rodgers, Jr., *supra* note 19, at 574.
36. EPA DDT REVIEW, *supra* note 26, at 251.
37. *See* Wargo, *supra* note 18, at xi ("Anyone growing up in the United States during the 1950s probably spent more than a few nights sleeping between a mattress and blanket, each impregnated with DDT.").
38. *See* Morriss & Meiners, *supra* note 19, at 7 ("DDT became so popular it was even thrown in place of rice at some weddings.").
39. To promote the widespread use of pesticides, the government funded programs to teach farmers "the virtues of pest control," how to apply pesticides, and how to "discover new means of using pesticides to make agriculture more productive." Morriss & Meiners, *supra* note 19, at 8.
40. Although USDA began to phase out its own spraying of DDT in 1958, it did not cancel DDT registrations under the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA") for many food crops and commercial agricultural uses until October 1972. *See* EPA DDT REVIEW, *supra* note 26, at 253–56.
41. *See* Morriss & Meiners, *supra* note 19, at 15.
42. Rachel Carson, Silent Spring (Houghton Mifflin 1994) (1962).
43. Wargo, *supra* note 18, at 81–82.
44. *See* EPA DDT REVIEW, *supra* note 26, at 252 ("The Governmental Committee issued reports included (1) a May 1963 Report by the President's Science Advisory Committee, (2) a November 1965 Report by the Environmental Protection Panel; (3) a May 1969 Report by the National Research Council, and (4) a December 1969 Report by the Mrak Commission.").
45. *See generally* EPA DDT REVIEW, *supra* note 26 (discussing the scientific basis for banning DDT).
46. The USDA characterized its own decisionmaking as "much too arbitrary." Pesticide Regulation Task Force, USDA, Report of the Task Force on the Pesticide Regulation Division 15 (1965); *see also* Rodgers, Jr., *supra* note 19, at 571–72 (calling USDA "scandalously derelict in enforcing FIFRA" and regulation of pesticides "undermined by administrative ineptitude, indifference and corruption").
47. *See* Morriss & Meiners, *supra* note 19, at 10, 15 ("While we can look back skeptically upon their behavior now, there is no doubt that the sense of mission in promoting agriculture through pesticide use was sincere and made the special interests' work easier by giving a public interest rationale for the programs they sought" and "there is no need to assume bad motives for the USDA employees who undoubtedly believed they were ridding the nation of dangerous pests").

the idea of better living through chemical insecticides;[48] (2) unshakeable dedication to a narrow mission of achieving higher crop yields; and (3) arrogant faith in man's ability to control technology and nature.

As with bloodletting and the plague, the point is *not* that humans erred. Humans will and should act despite the likelihood of error. The point is that regulators should have *expected* they might err. Regulatory safeguards should have been in place for identifying and rectifying errors at the outset of agency use, promotion, and regulation of DDT. As Carson recognized in *Silent Spring*:

> No responsible person contends that insect-borne disease should be ignored. The question that has now urgently presented itself is whether it is either wise or responsible to attack the problem by methods that are rapidly making it worse. The world has heard much of the triumphant war against disease through the control of insect vectors of infection, but it has heard little of the other side of the story—the defeats, the short-lived triumphs that now strongly support the alarming view that the insect enemy has been made actually stronger by our efforts. Even worse, we may have destroyed our very means of fighting. . . . What is the measure of this setback? The list of resistant species now includes practically all of the insect groups of medical importance. . . . Malaria programmes are threatened by resistance among mosquitoes. . . . Practical advice should be 'Spray as little as you possibly can' rather than 'Spray to the limit of your capacity.' . . . Pressure on the pest population should always be as slight as possible.[49]

Regulators not only erred, but their hubris prolonged and delayed corrective action.

B. *Playing with Fire: Fire Suppression Follies*

Federal fire policy in the United States illustrates yet another arrogantly calamitous error in regulatory judgment. Although ever-present on the landscape,[50] for many decades, the U.S. Government unwaveringly and unshakably embraced the notion that humans should and could extirpate all wildfire on public lands. As a consequence, regulators held fast to a flawed policy of all-out fire suppression that over the long term led to declines in forest health, cost taxpayers dearly, and left some forests at greater risk to supersized conflagrations.[51]

The federal government's approach toward fire underwent a regrettable transformation in the early 1900s. On the heels of the deadly fire season of 1910,[52] and not long after Congress established the first public land reserves (national parks) and moved responsibility for the new reserves to the Bureau of Forestry (renamed the Forest Service),[53] the agency regulators adopted a fire suppression policy with the goal of putting an end to all wildfires:

> Although light burning proponents in California and elsewhere continued to argue that fire could serve beneficial purposes (both in maintaining resilient forest ecosystems and safeguarding against catastrophic fires), the Forest Service adopted a fire exclusion policy that treated every fire, regardless of its source or location, as a threat and subject to extinguishment.[54]

For some charged with the work of extinguishing fire, the suppression effort would be likened to the "moral equivalent of war,"[55] a comparison that continues to resonate to this day.[56]

Moreover, in what could easily be described as a *know-it-all* attitude, "[a]ny effort to reinstitute light burning was resisted actively, as were calls for scientific studies to examine whether fire might play a beneficial role in forest health."[57] Suppression of contradictory opinion apparently went hand in hand with suppression of fire.[58] This hubristic attitude fell in line with a larger tradition of the times: scientific smugness. According to the renowned fire historian (and proclaimed professional pyromaniac) Stephen Pyne: [59]

> [M]odern science progressively declared itself the oracle and arbiter of fire. The magic of flame was deconstructed into the oxygen-chemistry of combustion. Ancient practices—constraints as well as powers—were dismissed as rural inertia and dangerous superstition; the burning of the woods to cleanse it of ticks and blight seemed no different than burning witches. Folklore had to compete with natural phi-

48. Professor Rodgers described the pesticide situation in 1970 as "technology run amok" and pondered whether civilized man was capable of controlling his modern technology through law. *See* Rodgers, *supra* note 19, at 568. It seems to me that government's conceited faith in technology allowed DDT to run amok.
49. Carson, *supra* note 42, at 266–267, 275.
50. *See* Stephen J. Pyne, America's Fires: Management on Wildlands and Forests 1 (1997) ("Fire has existed on Earth since lightning first struck terrestrial plants amid an oxygenated atmosphere some 400 million years ago."). And people across the earth have been playing with fire for thousands, perhaps even tens of thousands of years. *Id.* at 14.
51. *See* Robert B. Keiter, *The Law of Fire: Reshaping Public Land Policy in an Era of Ecology and Litigation*, 36 Envtl. L. 314 (2006); Stephen J. Pyne, *The Perils of Prescribed Fire: A Reconsideration*, 41 Nat. Res. J. 1 (2001); Rebecca K. Smith, *War on Wildfire: The U.S. Forest Service's Wildland Fire Suppression Policy and its Legal, Scientific, and Political Context*, 15 U. Balt. J. Envtl. L. 25, 38–39 (2007) (identifying various factors, along with fire suppression, as causes of large wildfires).
52. *See* Pyne, *supra* note 50, at 17.
53. *See id.* at 16.
54. Keiter, *supra* note 51, at 306; *see also* Jonathon Yoder, *Liability, Regulation, and Endogenous Risk: The Incidence and Severity of Escaped Prescribed Fires in the Untied States*, 51 J.L. & Econ. 297 (2008) ("In the early twentieth century, the U.S. Federal land management agencies and other related institutions moved away from active use of prescribed fire to focus almost exclusively on fire suppression.").
55. William James, On the Moral Equivalent of War (1906), *reprinted in* Representative Essays in Modern Thought 519 (Harrison Ross Steeves ed., 1913).
56. *See* Pyne, *supra* note 50, at 22–23 ("The public saw fire as weaponry, as blitzed cities, as sabotage, and thanks to *Bambi* (released in 1942), as a form of ecological murder . . . the Cold War confirmed the image of firefighting as an act of national defense"); Andy Stahl, *Symposium Speech: Fire Ecology 101 for Lawyers*, 19 J. Envtl. L. & Litig. 217, 217–22 (2004).
57. Keiter, *supra* note 51, at 306–07.
58. *See id.* at 307 ("[T]he Forest Service suppressed several research studies that seemed to endorse the use of prescribed fire in the southern pine woods.").
59. Wade Graham, *Burn It To Save It*, L.A. Times, Oct. 20, 2002, http://articles.latimes.com/2002/oct/20/magazine/tm-fire42.

losophy; folk fire practices with the precepts of academic *philosophes*.[60]

The federal government's fire eradication effort held firm for many decades.[61] In the 1920s, "light burning was officially condemned as anathema, dismissed as forestry's equivalent to circle-squaring and perpetual-motion machines."[62] In the 1930s, federal fire control efforts expanded[63] rather than give way to notions of an ecological benefit of fire.[64] During this period the Forest Service adopted its "10 AM policy," continuing and upping the ante of its get-tough-on-fire policy.[65] The 10 AM policy "stipulated that every fire would be controlled by 10 AM the morning following its report, or failing that, by 10 AM the next day."[66] Again, any questions of whether the policy was "the right strategy or whether it was truly possible were brushed aside."[67] The federal government pursued fire suppression with an overconfident attitude characterized by unquestioned support and an open wallet.[68] The 10 AM policy "gave suppression virtual carte blanche, the Roosevelt Administration lavished men and money on it, and professional forestry drowned out the voices of doubters."[69] In the 1940s, the Forest Service even boosted its wildfire eradication policy with a potent public education program that continues to this day: the iconic Smokey Bear ("Only YOU Can Prevent Forest Fires") campaign.[70]

It wasn't until 1977 that the 10 AM policy gave way to alternatives to immediate suppression.[71] A long time in coming, a failed policy was finally recognized as a failure. Historian Stephen Pyne explains the shift this way:

> By 1978, a century after John Wesley Powell published his damning map of the Utah firescape, the federal agencies had reformed their official policies in the hopes of reintroducing more fire. Economics argued that fire suppression had passed a point of diminishing returns. Contemporary ecology insisted that fire had a role in natural or quasi-natural systems; that its eradication could destabilize landscapes and allow fuels to stockpile to the point of detonation. Environmental politics rewrote agency charters, pivoting about America's fascination with wilderness. What began as an incongruity—suppressing lightning fires in nature reserves—became an anomaly. As stresses built, the tectonic plates of federal programs ruptured. Paradigms shifted. Policy changed.[72]

In the mid-1990s, the federal agencies admitted error and "professional forestry issued a public *mea culpa* that its founding fire philosophy had been wrong."[73] By 2002, even the beloved fire suppression icon Smokey Bear was forced to share the forest stage with a new celebrity rodent, Reddy Squirrel.[74] Reddy Squirrel's message—"Forest Fires Happen, Be Ready"—confirms the tectonic policy shift on fire.[75] According to Reddy's creators,

> "Reddy recognizes that Smokey Bear didn't quite get it right. We can't prevent all forest fires. And not only that, we probably shouldn't prevent all forest fires. Fire is a natural part of our forest ecosystems and by trying to put them all out we've made our forests unhealthy."
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> . . . Reddy . . . believes managers should learn to work with natural processes that include wildfires. "We can no more prevent fire than we can prevent hurricanes and tornadoes and wind and rain and sunshine. Fire is a natural part of our environment."[76]

Tragically, the interim consequences of the many decades of virtually sacrosanct fire suppression were deadly and devastating. Hundreds of firefighters lost their lives.[77] Taxpayers paid bloated, bovine-sized sums for fire suppression services and fire suppression equipment—easily in the millions and even billions of dollars cumulatively, over the decades.[78] And,

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60. Pyne, *supra* note 50, at 15.
61. One explanation for continued support for suppression efforts was that wet weather patterns may have misled regulators into believing suppression worked better than it did. *See* Stahl, *supra* note 56, at 221 ("When it appeared during the mid-twentieth century that our troops were winning the war on fire, in reality, the enemy was simply hunkered down by a wet climate, biding its time until condition were ripe for an offensive.").
62. *See* Pyne, *supra* note 50 at 17.
63. *See* Smith, *supra* note 51, at 27–28 (discussing large-scale suppression efforts initiated in 1930s).
64. *See* Keiter, *supra* note 51, at 306–307.
65. *See id.* at 307; *see also* Stephen J. Pyne, *The Perils of Prescribed Fire: A Reconsideration*, 41 Nat. Res. J. 1, 1 (2001).
66. Pyne, *supra* note 65, at 1.
67. *Id.* ("Enthusiasts explained away continued breakdowns by the failure of the policy to enjoy the political support it deserved and the money it required.").
68. *See* Smith, *supra* note 51, at 31 (Initially and until the late 1970s, "the Forest Service operated under the 'blank check' policy, which allowed it to be reimbursed for its fire suppression expenditures during the wildfire season, as well as for pre-suppression expenditures such as equipment purchases.").
69. Pyne, *supra* note 65, at 1.
70. *See Campaign History: American Icon*, SmokeyBear.com, http://www.smokeybear.com/vault/history_main.asp (last visited Jan. 7, 2011) ("Smokey Bear is America's wildfire prevention icon. He has educated generations of Americans about their role in wildfire prevention. Created in 1944, the Smokey Bear Wildfire Prevention campaign is the longest running public service advertising campaign in U.S. History.").
71. Smith, *supra* note 51, at 33.
72. Pyne, *supra* note 50, at 23.
73. *Id.* at 28, 30.
74. Credit goes to Professor Frederico Cheever, who first introduced me to Reddy Squirrel during his presentation at the Natural Resources Law Teachers Conference in Chico Springs in 2009. *See* Gillian Flaccus, *Smokey Bear, Meet Reddy the Squirrel*, Dall. Morning News, Aug. 22, 2002, at B12. Although children can still take the Smokey Pledge (now even on the internet, http://www.smokeybear.com/take-pledge.asp), Forest Service Employees for Environmental Ethics launched the Reddy Squirrel public education campaign in 2001. *Id.* That same summer, a number of newspapers across the country ran a cartoon showing an "indignant Smokey Bear one paw wrapped around a mug of beer, the other pounding the bar: '50 years I've given them ... So fire suppression didn't work out ... but to be replaced by a freakin' squirrel???'" Jennifer Snelling, *Smokey Bear's Squirrelly Sister*, Envtl. Magazine, http://www.emagazine.com/view/?394 (last visited Aug. 29, 2010).
75. *See* Gilliam Flaccus, *Smokey Bear Revamps Fire Message*, Associated Press, Aug. 19, 2002, *available at* http://newsmine.org/content.php?ol=nature-health/environment/forests/smokey-bear-revamps-fire-message.txt (last visited Jan. 7, 2011) ("Smokey's new campaign qualifies his age-old message [by stressing] the idea of 'good fire' vs. 'bad fire' . . . . [and] even discuss[ing] the benefits of lighting controlled fires to thin forests ripe for ignition—a deviation from Smokey's original creed.").
76. *Upstart Squirrel Challenges Old Forest Fire Bear,* Voice of America (Dec. 8, 2002), http://www.voanews.com/english/news/a-13-a-2002-12-08-5-Upstart-66271802.html.
77. Between 1911 and 1980 over 500 firefighters lost their lives. *See* Nat'l Interagency Fire Ctr., Wildland Fire Fatalities by Year (2007), *available at* http://www.nifc.gov/safety/reports/year.pdf.
78. Smith, *supra* note 51, at 31–32. Expenditures for fighting wildfires rose steeply between the 1920s and 1980s, increasing from several thousand dollars to over

the fire abolition policy sickened the very forest ecosystem it aimed to protect. The lands the federal agencies "held in public trust were, after a century, often [in] shambles. Forest health . . . had become a public scandal. Too many forests were overgrown, diseased, insect-infested, unattractive, prone to species losses, and vulnerable to catastrophic fire."[79] Fire suppression turned out to be responsible, at least in part, for many harms, including forest erosion and soil compaction,[80] invasive species introductions,[81] over-salvaging of timber,[82] and fire retardant contamination of forest rivers and streams.[83]

In summary, the government's fire suppression policy—adopted with scant acknowledgment of, or provision for, the possibility of mistake and with disdain for alternative solutions—spawned a misguided and costly public policy error. As government regulators' calculations of fire control went awry, a number of factors such as agency inertia, special interests, and weather patterns, as well as a boatload of hubris, kept a flawed policy afloat.

C. Of Swamps and Swagger

The history of wetlands in the United States conjures up yet a third calamity of hubristic environmental decisionmaking. Generally perceived as worthless wastelands of pestilence and unproductivity, [84] the United States vanquished wetlands across the nation with swiftness and enthusiasm. Without any apparent reservations, federal and state governments actively legislated, adjudicated, regulated, and funded comprehensive de-swamping.[85]

In line with long held views, at least in western parts of the world, of wetlands as sinister, forbidding, and valueless,[86] Congress encouraged wetlands draining in the United States with passage of the Swamp Lands Acts of 1849, 1850, and 1860.[87] The Acts granted over 64 million acres of federally owned wetland areas to specified states[88] for the purpose of facilitating conversion by drainage to more productive uses.[89] The Acts also required the states to dedicate all proceeds from these transfers exclusively to drainage efforts.[90] Federal support for agriculture, subsidies for disaster insurance, and funding of channelization and flood-control projects additionally helped pay for the draining and filling of wetlands.[91]

The federal judiciary aided the swampland drain game. For many decades, federal courts fully accepted the "wetlands as wastelands" mantra, deeming wetlands legal nuisances[92] and abetting their draining and filling.[93]

> Most famously, the United States Supreme Court said that "[i]f there is any fact which may be supposed to be known by every body, and therefore by courts, it is that swamps and stagnant waters are the cause of malarial and malignant fevers, and the policy power is never more legitimately exercised than in removing such nuisances."[94]
>
> As explained by Professor Nagle,
>
> [T]he Court not only disparaged swamps as nuisances generally, but it also emphasized that damming of the crevasse dramatically increased the value of the land.
>
> . . .
>
> [Justice Shiras, writing for the Court] concluded that "the reclamation of swamp and overflowed lands was *not only not forbidden, but was recognized as the duty of the state*, in consideration of the grant of the public lands" by Congress in the first Swamp Act of 1849.[95]

State authorities seemingly, unhesitatingly, and willingly shouldered their duty. "By 1915, thirty-six states had enacted laws to facilitate the drainage of swamps and other

\$200,000 annually. *See* Pyne, *supra* note 50, at 27 fig.7b.

79. *See* Pyne, *supra* note 50, at 40.
80. Erosion and compaction can result from fire suppression activities such as bulldozing, fire line construction, and heavy machinery use. *See* Smith, *supra* note 51, at 28.
81. In forests, invasive species may arrive with the entry of fire suppression vehicles and equipment. *See id.* at 29. Note, however, that debate exists as to whether invasive species introductions are necessarily a negative environmental consequence.
82. Fire suppression activities such as human-ignited wildfires and post fire timber salvage operations can result in soil compaction, erosion, and the removal of tree debris with value to surviving wildlife and ecosystem processes. In addition, these activities provide political cover for the commercial logging of healthy trees not otherwise subject to sale. *See id.* at 30.
83. *See id.* at 29; *see also* Stahl, *supra* note 56, at 219 (The Forest Service dumps an average of 15 million gallons of fire retardant annually.).
84. *See* Jonathan H. Adler, *Wetlands, Waterfowl, and the Menace of Mr. Wilson: Commerce Clause Jurisprudence and the Limits of Federal Wetland Regulation*, 29 Envtl. L. 1, 19–20 (1999); Daryn McBeth, *Wetlands Conservation and Federal Regulation: Analysis of the Food Security Act's "Swampbuster" Provisions as Amended by the Federal Agriculture Improvement and Reform Act of 1996*, 21 Harv. Envtl. L. Rev. 201, 214–15 (1997); John Copeland Nagle, *From Swamp Drainage to Wetlands Regulation to Ecological Nuisances to Environmental Ethics*, 58 Case W. Res. L. Rev. 787, 791–95 (2008); *see also* J.S. Larson & J.A. Kusler, Wetland Functions and Values: The State of Our Understanding, at v (1979) ("For most of recorded history, wetlands were regarded as wastelands if not bogs of treachery, mires of despair, homes of pests, and refuges for outlaw and rebel."); J.B. Ruhl et al., The Practice & Policy of Environmental Law 130 (2008) ("Wetlands were considered undesirable, swampy, mosquito-infested wastelands that truly were wasted if not converted to some better use ….").
85. *See* Adler, *supra* note 84, at 20 ("Indeed, for many decades it was active government policy to destroy wetlands."); Nagle, *supra* note 84, at 792–94.
86. *See* William J. Mitsch & James G. Gosselink, Wetlands 15–16 (4th ed. 2007).
87. Swamp Land Act of 1849, ch. 87, 9 Stat. 352; Swamp Land Act of 1850, ch. 84, 9 Stat. 519; Swamp Land Act of 1860, ch. 5, 12 Stat. 3 (codified as amended at 43 U.S.C. §§ 981–994 (2006)).
88. *See Wetlands of the United States: Their Extent and Their Value to Waterfowl and Other Wildlife – A Century of Wetland Exploitation*, U.S. Geological Survey (Aug. 3, 2006), http://www.npwrc.usgs.gov/resource/wetlands/uswetlan/century.htm (64,895,415 acres of wetlands patented to 15 states).
89. 43 U.S.C. § 982 (Granting swamp lands to states "to reclaim the swamp and overflowed lands therein … made unfit thereby for cultivation…"); *see also* Nagle, *supra* note 84, at 792–93.
90. 43 U.S.C. § 983 (Directing that the "proceeds of said lands...shall be applied exclusively, as far as necessary, to the reclaiming said lands, by means of levees and drains"); *see also* People v. Warner, 74 N.W. 705, 709 (Mich. 1898) (stating that swamp lands were granted so that states might acquire a fund for general drainage purposes).
91. *See* Adler, *supra* note 84, at 20.
92. *See* Nagle, *supra* note 84, at 789–96.
93. *See id.*
94. *Id.* at 791–92 (quoting Leovy v. United States, 177 U.S. 621, 636 (1900)).
95. *Id.* at 792 (emphasis added).

watery lands."[96] State courts, also adopting the swamp mantra of the times, supported state policies favoring wetlands destruction.[97]

As a consequence of a wetlands policy formed by a confidently held misperception, the nation vanquished half the wetlands that had been in existence at the time of colonial settlement.[98] This reduction, following "decades of steady losses,"[99] represents a sizable loss of more than 100 million acres,[100] and a colossal loss of environmentally derived public amenities and services.

Today, in a complete about-face on previously held *truths*, wetlands now lay claim to the title "most productive and valuable ecosystems in the world."[101] And, although not necessarily this author's idea of high praise, some refer to wetlands with reverence as "nature's kidneys" and as "ecological supermarkets" because of the vital functions they perform:

> Wetlands are sometimes described as "the kidneys of the landscape" because they function as the downstream receivers of water and waste from both natural and human sources. They stabilize water supplies, thus ameliorating both floods and drought. They have been found to cleanse polluted waters, protect shorelines, and recharge groundwater aquifers.
>
> Wetlands also have been called "ecological supermarkets" because of the extensive food chain and rich biodiversity that they support. They play major roles in the landscape by providing unique habitats for a wide variety of flora and fauna. Now that we have become concerned about the health of our entire planet, wetlands are being described by some as important carbon sinks and climate stabilizers on a global scale.[102]

Taking these identified values and functions into account, the loss of 100 million acres of wetlands translates well beyond the loss of physical acreage to a colossal loss in ecosystem functioning (lost habitat and ecosystem stability) and of public and private economic benefit (lost ecosystem services). On the "biological-kidney" side, wetlands are rich in plant and wildlife species, with as many as or more than 5000 species of plants, 190 species of amphibians, and 270 species of birds found in the nation's wetlands.[103] Moreover, over three quarters of wildlife species in more arid regions of the nation, and a disproportionately high number of endangered and threatened species across the nation, rely on wetlands for survival.[104]

On the "biological supermarket" side, wetlands contribute to timber, fish, and wildlife commercial harvests.[105] In fact, the vast majority of commercially harvested fish and shellfish are wetland-dependent.[106] Wetlands also contribute to recreational enterprises, including hunting, hiking, fishing, nature photography, and birdwatching.[107] Additionally, scientists now link wetlands with water purification, soil quality enhancement, and flood and erosion control.[108] With respect to the latter the U.S. Environmental Protection Agency ("EPA") has observed that

> [w]etlands function as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater and flood waters. Trees, root mats, and other wetland vegetation also slow the speed of flood waters and distribute them more slowly over the floodplain. This combined water storage and braking action lowers flood heights and reduces erosion. Wetlands within and downstream of urban areas are particularly valuable, counteracting the greatly increased rate and volume of surface water runoff from pavement and buildings.
>
> The holding capacity of wetlands helps control floods and prevents water logging of crops. Preserving and restoring wetlands, together with other water retention, can often provide the level of flood control otherwise provided by expensive dredge operations and levees.[109]

Louisiana's coastal wetlands situation epitomizes the devastating environmental consequences of wetlands eradication.[110]

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96. *Id.* at 793. Note, however, that more recent data reflect a trend reversal and some steady improvements. *See* Jonathan H. Adler, *Freshwater: Sustaining Use by Protecting Ecosystems*, 39 Envtl. L. Rep. 10309, 10311 (2009) (citing Thomas E. Dahl, U.S. Fish & Wildlife Serv., Status and Trends of Wetlands in the Conterminous United States 1998 to 2004, at 15 (2006)), *available at* http://www.elr.info/articles/vol39/39.10309.pdf.
97. *See* Nagle, *supra* note 84, at 790–91 (discussing decisions of New Hampshire, Rhode Island, New York, and North Carolina state courts disparaging swamps as nuisances and ruling favorably on drainage).
98. *See* Adler, *supra* note 84, at 21–22; *see also* Ruhl et al., *supra note* 84, at 130 (citing Dahl, *supra* note 93; U.S. Fish & Wildlife Serv., Status and Trends of Wetlands in the Conterminous United States 1986 to 1997 (2000); USDA, Natural Res. Conservation Serv., National Resources Inventory (2000)).
99. Adler, *supra* note 96; *see also* U.S. Fish & Wildlife Serv., Status Report for the National Wetlands Inventory Program: 2009, at 4 (2009) (reporting that "from the mid-1950s to the mid-1970s . . . 458,000 acres of wetlands were lost annually").
100. Adler, *supra* note 84, at 21–22; Ruhl et al., *supra* note 84, at 8 (Freshwater wetlands have suffered to a greater extent than coastal wetlands and the regional distribution thereof. For example, there are six states with losses of more than 85%, twenty-two states with losses of more than 50%, and all of the lower forty-eight states have sustained losses of at least 20%.).
101. McBeth, *supra* note 84, at 203; *see also* Mitsch & Gosselink, *supra* note 86, at 3 ("Wetlands are among the most important ecosystems on the Earth."); U.S. Fish and Wildlife Serv., Status Report for the National Wetlands Inventory Program: 2009, at xi (2009) ("Wetlands are the cornerstone of the Nation's most ecologically and economically important ecosystems.").
102. Mitsch & Gosselink, *supra* note 86, at 4.
103. McBeth, *supra* note 84, at 204–05.
104. *See* U.S. Fish and Wildlife Serv., *supra* note 98, at 8–9 (estimating 46% of endangered or threatened species are associated with wetlands and 80% of wildlife in humid regions dependent on wetlands); McBeth, *supra* note 84, at 204.
105. *See* McBeth, *supra* note 84, at 204.
106. *See id.* at 205–06 (citing data that over 95% of commercially harvested fish and shellfish are wetland-dependent and that timber varieties located in wetlands are worth about $8 billion).
107. *See id.* at 205, 207 (identifying commercial values linked with various recreational activities at or associated with wetlands along with a range of aesthetic values).
108. *See Wetlands and People*, Envtl. Prot. Agency, http://water.epa.gov/type/wetlands/people.cfm (last updated Dec. 17, 2009).
109. Envtl. Prot. Agency, America's Wetlands: Our Vital Link Between Land and Water 8–9 (1995).
110. There are also significant economic consequences to wetlands eradication. According to data collected by America's Wetland Resource Center, "[i]f America's [wetland] continues to erode at present rates, $103 billion in assets will experience increased flood risks." *America's Wetland Official Numbers*,

> Louisiana is losing its protective fringe of marshes and barrier islands faster than any place in the U.S. Since the 1930s some 1,900 square miles [4,900 square kilometers] of coastal wetlands—a swath nearly the size of Delaware or almost twice that of Luxembourg—have vanished beneath the Gulf of Mexico. Despite nearly half a billion dollars spent over the past decade to stem the tide, the state continues to lose about 25 square miles [65 square kilometers] of land each year, roughly one acre every 33 minutes.[111]

As a result, in the century preceding Hurricane Katrina, "erosion essentially brought New Orleans thirty miles closer to the Gulf, so that by 2005 the ocean was only twenty miles away with more than half of its natural protection gone."[112]

Like a deathly exhalation of the Grim Reaper's breath, Hurricane Katrina inflicted a horrifically deadly and tremendously costly toll on Louisiana and the nation.[113] In the storm's wake, scientists, lawyers, and academics tagged the wetlands losses of the previous decades a significant factor in the magnitude of flooding and post-hurricane damage.[114] Some have gone so far as to assert that had the coastal wetlands east of the Mississippi River been healthy in 2005, "the U.S. would have saved tens of billions of dollars after Hurricanes Katrina & Rita."[115]

Today, many Louisiana locals have also come to accept and share this view:

> Since successive hurricanes have barreled up from the gulf unimpeded, causing mass devastation and loss of life, just about every resident of southern Louisiana has begun to view wetlands protection as a cause of existential importance. If the wetlands had been more robust when Hurricane Katrina's waters pushed up from the ocean, the damage might not have been as severe.[116]

Compounding the state's coastal wetlands situation, one of the worst ecological consequences of the 2010 BP oil spill in the Gulf of Mexico may potentially be the additional harm to coastal wetlands as oil from the spill reaches the shore.[117] In May 2010, the New York Times reported on a common fear related to this potential harm to wetlands:

> [W]hat is terrifying everyone from bird watchers to the state officials charged with rebuilding the natural protections of this coast is that it now seems possible that a massive influx of oil could overwhelm and kill off the grasses that knit the ecosystem together. Healthy wetlands would have some natural ability to cope with an oil slick, said Denise Reed, interim director of the Pontchartrain Institute for Environmental Sciences at the University of New Orleans. "The trouble with our marshes is they're already stressed, they're already hanging by a fingernail," she said. It is possible, she said, that the wetlands' "tolerance for oil has been compromised." If so, she said, that could be "the straw that broke the camel's back."[118]

America's Wetland Res. Ctr., http://www.americaswetlandresources.com/background_facts/thenumbers/ (last updated Apr. 18, 2006).

111. Joel K. Bourne, Jr., *Gone with the Water*, Nat'l Geographic, Oct. 2004, at 88, 96.

112. *See* John Stapleford, *Wetlands Mitigation: Retroactive Application of Clean Water Act,* 31 Wm. & Mary Envtl. L. & Pol'y Rev. 861, 881 (2007) (footnote omitted).

113. *See id.* at 880 ("On August 29, 2006, [sic] Hurricane Katrina made landfall in Louisiana. At the time Katrina was the strongest hurricane ever recorded in the Gulf of Mexico with its winds peaking at 175 mph. Katrina caused huge storm surges that breached the artificial levees protecting New Orleans and flooded much of the city. The current death toll stands at just over 1,700 with almost 2,000 more people still missing. In addition to the massive toll on human life, Katrina caused an estimated $81 billion of damage, making it by far the costliest hurricane in American history.") (footnotes omitted)*; see also Hurricanes Katrina and Rita's Impact on America's Wetland*, America's Wetland Res. Ctr., http://www.americaswetlandresources.com/background_facts/basicfacts/hurricane.html (last visited Jan. 16, 2011) (Hurricane Katrina's storm surge flooded about 80 percent of New Orleans, an area "more than seven times larger than Manhattan").

114. *See* R. Eugene Turner, *Doubt and the Values of an Ignorance-Based World View for Restoration: Coastal Louisiana Wetlands*, 32 Estuaries & Coasts 1054 (2009); Raymond B. Seed et al., Investigation of the Performance of the New Orleans Flood Protection System in Hurricane Katrina on Independent Levee Investigation Team: Final Report 14-4 (2006), *available at* http://works.bepress.com/rmoss/17; Stapleford, *supra* note 112, at 880 ("The seriously depleted condition of the coastal wetlands along the coast of Mississippi and Louisiana constituted one final aggravating factor" contributing to Hurricane Katrina damage); Bob Sullivan, *Wetlands Erosion Raises Hurricane Risks: Natural Storm 'Speed Bump' Around New Orleans Now Missing,* MSNBC.COM, http://www.msnbc.msn.com/id/9118570/ (last visited Jan. 16, 2011) (According to the Executive Assistant to the Governor for Coastal Activities, wetlands erosion has "a direct impact on New Orleans' ability to absorb the blow of a storm like Katrina . . . . For every 2.7 miles of wetlands, storm surges are reduced by about one 1 foot . . . "); *Hurricane Katrina: Assessing the Present Environmental Status: Hearing Before the Subcomm. on Env't and Hazardous Materials of the H. Comm. on Energy and Commerce*, 109th Cong. 8–9 (2005) (statement of Erik D. Olson, Senior Attorney, Natural Resources Defense Council) ("A century of poor planning and industrial abuse has stripped away much of the Gulf Coast's natural protection against storms and flooding. More than 1 million acres of coastal wetlands in Louisiana have been drained, lost to development, or starved of the Mississippi River sediments they need to survive. These wetlands could have absorbed storm surge and floodwaters, substantially reducing the storm's impact."). Attorneys filed claims based on similar arguments. *See* John P. Manard, Jr. et al., *Katrina's Tort Litigation: An Imperfect Storm*, 20 Nat. Resources & Env't 31, 36 (2006) ("Two federal class action lawsuits against oil and gas pipeline and production companies raise the interesting, hot-button issue of the relationship between historic oil and gas operations and Louisiana's diminishing wetlands. . . . The suits contend that the wetlands serve as a hurricane buffer, that oil and gas operations destroyed wetlands, and that the defendants are responsible for the additional loss of life and property that the wetlands buffer should have mitigated.").

115. *See America's Wetland in a Nutshell—FAQS*, America's Wetland Res. Ctr., http://www.americaswetlandresources.com/background_facts/basicfacts/FAQs.html (last visited Jan. 16, 2011).

116. Leslie Kaufman & Campbell Robertson, *Gulf Coast Towns Brace as Huge Oil Slick Nears Marshes,* N.Y. Times, May 1, 2010, at A1, A31.

117. *See id.* at A1 ("Oil gushed into the Gulf of Mexico unabated Saturday, and officials conveyed little hope that the flow could be contained soon, forcing towns along the Gulf Coast to brace for what is increasingly understood to be an imminent environmental disaster. The spill, emanating from a pipe 50 miles offshore and 5,000 feet underwater, was creeping into Louisiana's fragile coastal wetlands as strong winds and rough waters hampered cleanup efforts.").

118. *Id.* at A31. As of the writing of this Article, the actual extent of the harm remained undocumented and uncertain, although the likelihood of harm is generally accepted. In May 2010, the New York Times reported on the uncertain extent of anticipated harm:

> The oil spill in the Gulf of Mexico is bad -- no one would dispute it. But just how bad? Some experts have been quick to predict apocalypse, painting grim pictures of 1,000 miles of irreplaceable wetlands and beaches at risk, fisheries damaged for seasons, fragile species wiped out and a region and an industry economically crippled for years . . . .
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> . . . .
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> The economic impact is as uncertain as the environmental damage. With several million gallons of medium crude in the water already, some experts are predicting wide economic harm. Experts at the Harte Research Institute for Gulf of Mexico Studies in Corpus Christi, for example, estimated that as much as $1.6 billion of annual economic activity and services -- including effects on tourism, fishing and even

The drawn out, but total transformation from shared revulsion of wetlands to their unqualified reverence illustrates a devastating consequence of hubris in environmental decisionmaking. The historic practice of bloodletting is not so far removed from the more contemporary policies of fire suppression and wetlands draining. These policies exhibit stubborn overconfidence and the prolonged retention of an erroneous strategy.

As with the mistakes associated with bloodletting, the plague, DDT use, and fire suppression, the mistakes of wetlands regulation grew in substantial part from regulatory hubris in the face of scientific uncertainty, ecosystem complexity, and imperfect information.

III. Where Does All That Hubris Come From?

Our tendency towards environmental regulatory hubris—conceit regarding our ability to beneficially and benignly manipulate the environment for humankind (and at times other species) in the face of overwhelming evidence of past errors, miscalculations, and failures may be at least partially explained by our attitudes and by human nature. Strongly held cultural beliefs, along with theories from psychology on human nature, offer clues as to the sometimes gaping disconnect between our regulatory confidence and our less than salutary environmental results.[119]

A. Religious Values: Is It God's Fault?

Religious values have long shaped perceptions about the world and the environment, and in the United States, Judeo-Christian beliefs have long dominated religious values.[120] Some of these religious beliefs have arguably contributed to our regulatory hubris. One thread in particular, the Dominion Tradition, not only places man apart and above nature, but reveals (conveniently) that it is God's will that man subdue nature for his own ends:[121]

> And God said, Let us make man in our image, after our likeness: and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth.
>
> So God created man in his own image, in the image of God created he him; male and female created he them.
>
> And God blessed them, and God said unto them, Be fruitful, and multiply, and replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth. [122]

Belief in man's dominance over all living things (conferred directly from God), in concert with the beliefs that God formed man in his image, and that all living things exist for man, could certainly instill—and even inculcate—a sense of superiority and conceit concerning not only our right, but *our ability* to control, via legislation or regulation, the environment for whatever ends we desire.

Lynn White, a professor of medieval history, first identified this problem, but took it much further.[123] He blamed Western religious attitudes toward nature for the worsening ecological crisis ("we shall continue to have a worsening ecologic crisis until we reject the Christian axiom that nature has no reason for existence save to serve man") and for our inability to find *any* workable solutions to ecological degradation ("[b]oth our present science and our present technology are so tinctured with orthodox Christian arrogance toward nature that no solution for our ecologic crisis can be expected from them alone").[124]

This Article's argument is less sweeping. It is merely that a widely shared—be it overt or subliminal—belief in man's God-like and God-given superiority over nature may infuse a degree of overconfidence with respect to our ability and competence to understand, manage, control, and regulate the environment. This author shares, however, White's view[125] that greater "humility" positions us better to solve environmental crises.[126]

B. The Scientific Revolution: Too Much Enlightenment?

Following the Scientific Revolution, America's great faith in and high esteem for science and for the scientific method may also account for some of our hubristic tendencies.[127] Historian Robert Hatch offers this definition of the Scientific Revolution:

> By tradition, the "Scientific Revolution" refers to historical changes in thought [and] belief, to changes in social [and] institutional organization, that unfolded in Europe between roughly 1550–1700; beginning with Nicholas Copernicus (1473–1543), who asserted a heliocentric (sun-centered) cosmos, it ended with Isaac Newton (1642–1727), who proposed universal laws and a Mechanical Universe.[128]

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less tangible services like the storm protection provided by wetlands -- could be at risk. "And that's really only the tip of the iceberg," said David Yoskowitz, who holds the endowed chair for socioeconomics at the institute. "It's still early in the game, and there's a lot of potential downstream impacts, a lot of multiplier impacts."
John M. Broder et al., *NEWS ANALYSIS; Bad. But an Apocalypse?,* N.Y. Times, May 4, 2010, at A19.

119. The inverse is also true; environmental law influences our values. *See* Doremus, *supra* note 22, at 355–57.
120. *See* Robert V. Percival et al., Environmental Regulation: Law, Science, and Policy 11 (6th ed. 2009).
121. *See* Lynn White, *The Historical Roots of Our Ecological Crisis*, 155 Science 1203 (1967).
122. *Genesis* 1:24–1:26 (King James).
123. White, *supra* note 121, at 1207.
124. *Id.*
125. *See id.* at 1206–07 (offering up as a remedy Saint Francis of Assisi's belief in the "virtue of humility" to successfully inspire technological and scientific remedies for ecological crises (and nominating Assisi a patron saint for ecologists)).
126. For further discussion, *see infra* Part IV.
127. As someone who majored in biology, worked in an immunology research laboratory for a time, and pursued a master's degree in a science-oriented field, I readily admit to falling within the category of those who believe strongly in the power of science and the scientific method.
128. Dr. Robert Hatch, *Definition—Concept—History*, Scientific Revolution, http://web.clas.ufl.edu/users/rhatch/pages/03-Sci-Rev/SCI-REV-

Others describe the Scientific Revolution more dramatically:

> Since that revolution overturned the authority in science not only of the middle ages but of the ancient world—since it ended not only in the eclipse of scholastic philosophy but in the destruction of Aristotelian physics—it outshines everything since the rise of Christianity and reduces the Renaissance and Reformation to the rank of mere episodes, mere internal displacements within the system of medieval Christendom. Since it changed the character of men's habitual mental operations even in the conduct of the non-material sciences, while transforming the whole diagram of the physical universe and the very texture of human life itself, it looms so large as the real origin both of the modern world and of the modern mentality that our customary periodisation of European history has become an anachronism and an encumbrance.[129]

During the Scientific Revolution great advances in physics, astronomy, and biology, and in the notion of scientific investigation itself, transformed our view of the universe and our place within it.

This great transformation, however, also elicited an egotistical view of our role in the world and our control over the workings of the universe. Not coincidentally, the Dominion Tradition has its fingerprints all over the Scientific Revolution.[130] Historian Carolyn Merchant describes the transformation following the Scientific Revolution as one where "the image of an organic cosmos . . . gave way to a mechanistic world view in which nature was reconstructed as dead and passive, to be *dominated and controlled by humans*."[131] Hubris thus accompanied both our religious traditions and our newfound scientific understanding of the universe. Merchant notes that Francis Bacon, the "'celebrated father of modern science,' transformed tendencies already extant in his own society into a total program advocating the control of nature for human benefit."[132] Bacon "fashioned a new ethic sanctioning the exploitation of nature"[133] whereby "[h]uman dominion over nature, an integral element of the Baconian program, was to be achieved through the experimental 'disclosure of nature's secrets.'"[134] Similarly, Descartes, "considered to be the 'father' of modern Western philosophy," held the position that "the new science would make humans the 'masters and possessors of nature.'"[135] Accordingly, "[s]eventeenth-century scientists, reinforcing aggressive attitudes toward nature, spoke out in favor of 'mastering' and 'managing' the earth."[136] In this way, asserts Merchant, "[t]wo new ideas, those of mechanism and of the domination and mastery of nature, became core concepts of the modern world."[137] Science offered not only a systematic means to collect information on, gain knowledge about, and better understand the workings of the universe, but at least for some,[138] also the authority, obligation, and divine-like ability to manipulate it to our whims.

The prevailing anthropocentric worldview associated with the Scientific Revolution and Western religion[139]—that tends to place man front and center, above all of nature—surely accounts for a certain amount of our hubris in the realm of environmental and natural resources regulation. Whether, with supreme confidence, we use our abilities to benefit ourselves by exploiting, conserving, or preserving the environment, or more bio-centrically, attempt to benefit other species on the basis of their own intrinsic value, our actions reflect the rather smug, core presumption that with science we *can* master our environment for whatever purposes we desire. Such confidence in human ability is the quintessence of chutzpah.[140]

C. *Technological Optimism: Boys and Their Toys?*

Similarly, the great confidence many Americans place in technological innovation may partly account for our hubristic tendencies. Americans' "technological optimism," closely related to the idea of "American exceptionalism,"[141] reflects a "broad belief in the power of American technology to conquer any obstacle,"[142] specifically including environmental problems:[143]

Teaching/03sr-definition-concept.htm.

129. *See* Herbert Butterfield, The Origins of Modern Science 7–8 (rev. ed. 1997).
130. White, *supra* note 121, at 1206 ("From the 13th Century onward, up to and including Leibnitz and Newton, every major scientist, in effect, explained his motivation in religious terms.").
131. Carolyn Merchant, The Death of Nature: Women, Ecology and the Scientific Revolution, at xvi (1989) (emphasis added). Put more graphically, "'[b]y art and the hand of man,' nature can … be 'forced out of her natural state and squeezed and molded.'" *Id.* at 171.
132. *Id.* at 164. For a more positive spin on Francis Bacon's contribution to science, *see* Butterfield, *supra* note 129, at ch. 6.
133. Merchant, *supra* note 131, at 164.
134. *Id.* at 188.
135. George Sessions, *Ecocentrism and the Anthropocentric Detour*, *in* Ecology: Key Concepts in Critical Theory 165, 168 (Carolyn Merchant ed., 2d ed. 2008).
136. *See* Merchant, *supra* note 131, at 188. "The development of science as a methodology for manipulating nature, and the interest of scientists in the mechanical arts [early technology], became a significant program during the latter half of the seventeenth century." *Id.* at 186. Ironically, it should be noted that even Francis Bacon acknowledged the possibility of his own erroneous thinking and experimentation. *See* Butterfield, *supra* note 129, at 116.
137. *See* Merchant, *supra* note 131, at 2.
138. *See* Sessions, *supra* note 135, at 170 (explaining that contrary to the prevailing cultural ideology, some philosophers, scientists, and intellectuals, including Baruch Spinoza, Bertrand Russell, and Albert Einstein, failed to embrace the dominant anthropocentrism and presumptuous view of man's importance in nature).
139. *See* White, *supra* note 121, at 1205 ("Especially in its Western form, Christianity is the most anthropocentric religion the world has seen.").
140. The word *chutzpah* derives from Yiddish and translates to "utter nerve; effrontery." The American Heritage Dictionary of the English Language 344 (3d ed. 1992).
141. Christopher H. Schroeder, *Third Way Environmentalism*, 48 Kan. L. Rev. 801, 823 (2000) [hereinafter *Third Way Environmentalism*].
142. Christopher H. Schroeder, *Global Warming and the Problem of Policy Innovation: Lessons from the Early Environmental Movement*, 39 Envtl. L. 285, 297–98 (2009) [hereinafter *Global Warming and the Problem of Policy Innovation*] (the author ties American's spirit of technological optimism to the successful Apollo space mission: "Ever since, it has become rather common for an advocate of some bold national policy to proclaim, 'If we can put a man on the moon, surely we can do this as well.'") (internal citation omitted); *see also* James E. Krier & Clayton P. Gillette, *The Un-Easy Case for Technological Optimism*, 84 Mich. L. Rev. 405, 407 (1985) (technological optimism takes the position that "exponential technological growth will allow us to expand resources ahead of exponentially increasing demands" and was a response to the dire predictions set out in D.H. Meadows et al., The Limits to Growth (1972)) (internal citation omitted).
143. Krier & Gillette, *supra* note 142, at 405 (identifying "special relevance and a notable dominance" of technological optimism in fields of environmental law and natural resources).

> The environmental initiatives of the 1970s took major advantage of [a] … wave of technological optimism. At the same time as the country was coming to believe that we faced serious and urgent environmental problems, it also was convinced that as a nation we possessed the knowledge, resources, and innovative capacities to solve those problems, if only we would make "the national decisions [and] marshal[] the national resources required."[144]

Technological optimists believe in "unending human ingenuity, or at least human ingenuity with no foreseeable limit."[145] They would assert: "If the world is running short of food, we can count on technological innovation to increase the productivity of agricultural land and the acreage of arable land itself, through better seeds, better fertilizers, herbicides and pesticides, and better irrigation techniques,"[146] and "[i] f environmental quality is threatened, more effective pollution-control technology can be developed to deal with the problem."[147] Technological optimism, in this sense, constitutes an "article of faith."[148]

Commentators have identified both advantages[149] and disadvantages[150] of putting an abundance of faith in technological solutions. As with religious beliefs and our devotion to the scientific method, however, such enthusiastic confidence in human exceptionalism of intellect, inventiveness, ingenuity, and resourcefulness regarding technological innovation reflects an arrogant self-image, one of human infallibility. This long-standing[151] rosy outlook regarding our ability to always, eventually, devise technology to innovate our way around any and all environmental problems (for good or bad) may partially explain and contribute to our systemic overconfidence—our regulatory hubris—with respect to our ability to understand, manage, and regulate the environment.

D. Human Nature: Hardwired Hubris?

Observations from psychology may yield additional insights about our hubristic nature. What exactly about human nature leads us to the values, beliefs, and attitudes examined previously? The following discussion examines several theories—in an admittedly cursory fashion—for further clues about the source of our regulatory hubris.

In his book, *Why We Make Mistakes*, author Joseph Hallinan introduces the topic:

> When something goes wrong, the cause is overwhelmingly attributed to human error: airplane crashes (70 percent), car wrecks (90 percent), workplace accidents (also 90 percent). You name it, and humans are usually to blame. And once a human is blamed, the inquiry usually stops there. But it shouldn't—at least not if we want to eliminate the error. In many cases, our mistakes are not our fault, at least not entirely. For we are all afflicted with certain systemic biases in the way we see, remember, and perceive the world around us, and these biases make us prone to commit certain kinds of errors.[152]

In the remainder of his book, Hallinan describes scores of ways in which human beings are basically hard wired to err.[153] Significantly, according to research collected in his book, one reason we err is our general nature toward overconfidence.[154] Overconfidence apparently afflicts practically everyone (with the exception of the depressed) and induces us to commit errors small and large.[155] As Hallinan puts it "most of us hate to think of ourselves as average—or, God forbid, *below* average. So we walk around with the private conceit that we are above average, and in that conceit lies the seed of many mistakes."[156] In the context of environmental regulation where the complexities of the problems can be enormous, the uncertainties vast,[157] and the potential outcomes disastrous, it might seem that regulators would be less taken to such overconfidence. However, research by Hallinan suggests just the opposite: as the difficulty of particular tasks increases so too does the overconfidence.[158]

Hallinan also illustrates how people systematically and unknowingly recall past events in ways that tend to be more self-flattering than factually correct.[159] Experimenta-

144. *Global Warming and the Problem of Policy Innovation, supra* note 142, at 298 (internal citation omitted).
145. Krier & Gillette, *supra* note 142, at 409.
146. *Id.* at 407.
147. *Id.*
148. *Id.* at 409.
149. *See Global Warming and the Problem of Policy Innovation, supra* note 142 at 297–98 (asserting "the passage of innovative legislation owes a great deal to the undeniable spirit of technological optimism that dominated the public psyche" and that technological optimism played "a significant role" in generating legislative responses to public demand for congressional action); Krier & Gillette, *supra* note 142, at 428 (noting history of many technological successes and few tragic failures as argument in favor of technological optimism).
150. *See* Krier & Gillette, *supra* note 142, at 413 (noting, that technology is a "mixed blessing" that is "capable of producing undesirable as well as desirable consequences" and even aggravating some of the very problems it is advanced to solve); *Global Warming and the Problem of Policy Innovation supra* note 142, at 298 (noting technological optimism has at times allowed policy makers to defer hard environmental choices). For a summary of arguments against technological optimism *see* Andrew D. Basiago, *The Limits of Technological Optimism*, 14 The Environmentalist 17, 18 (1994).
151. *Third Way Environmentalism*, *supra* note 141, at 824 (noting that American technological optimism remains with us today, although the public's allegiance has shifted from the government to the private sector as the innovators of technological solutions).
152. Joseph T. Hallinan, Why We Make Mistakes 2 (2009).
153. *Id.* at 149.
154. *See id.* at 149–67.
155. *See id.* at 149–50. As an example, Hallinan sets out a survey by the U.S. Army in which soldiers at Fort Benning were asked predict how good a shot they were. When the Army then tested the soldier at the firing range it turned out 75% predicted they would hit more targets than they did and "more than one out of every four soldiers shot so poorly" that they failed to even meet the Army's qualification requirements. *Id.* at 155. In an analogous study, researchers asked University of Wisconsin students to "read one paragraph of text and rate themselves in terms of their confidence in their ability to draw the correct inferences from it." As with the soldiers, the students' confidence exceeded their actual ability. *Id.* at 156.
156. *Id.* at 149.
157. Doremus, *supra* note 22, at 319.
158. *See* Hallinan, *supra* note 152, at 161.
159. *See id.* at 59 ("Indeed, the tendency to see and remember in self-serving ways is so ingrained—and so subtle—that, like many of the other errors discussed in this book, we often have no idea we're doing it."). Policy Sciences theorists have come to somewhat similar conclusions. The field of policy sciences "consists of a set of integrated concepts or conceptual tools for framing thought and action and for guiding analysis, interpretation, and resolution of any problem." Tim W. Clark, The Policy Process: A Practical Guide for Natural Resource Professionals 4 (2002). According to policy sciences theory, people are "selectively attentive" such that they "tend to subordinate the external en-

tion reveals that this trait, known as hindsight bias, leads people to exaggerate or misremember facts in ways that present themselves in a more favorable light.[160] Hindsight bias may help to explain the tendency towards arrogant decisionmaking in the context of environmental regulation. If policymakers and regulators systematically and unknowingly recall their past decisions more favorably than actually justified, they may—also systematically and unknowingly—become more confident in their decisionmaking abilities than justified.

Apart from *why* we are hubristically-challenged—be it religion, human-nature, or just a bad attitude—the issue remains as to what, if anything, we can do about it. The next section explores some possibilities.

IV. Humility as a Regulatory Mindset

Humans are bound to err, and regulators are human. As shown by history, the makers and enforcers of environmental law not only err, but they have regulated arrogantly—discounting, dismissing, and disregarding the truth of human imperfection. As a result, at least on occasion, human health and environmental resources have been squandered and progress needlessly delayed. To do better, I suggest we seek more regulatory humility. We need to acknowledge our imperfection. We need to reframe our regulatory mindset to be less arrogant. Toward this end, the following sections discuss options for transitioning to a more humble environmental regulatory framework.[161] After all, nobody wants their blood let by leeches if it will not help.

A. Pre-Decision Safeguards

A number of regulatory front-end measures exist for tempering errors of overconfidence. Ideally, by embracing a more realistic sense of our limitations at the pre-decisional phases of regulatory actions, we can reduce errors *before* policy or program implementation.

1. Enhanced Peer Review

One option for moving towards a more humble regulatory approach would be enhancing the use of peer review in regulatory decisionmaking. In general, peer review calls for critiques by experts of ideas, methods, outputs, or information as a safeguard on the quality (and in some cases originality) of those ideas, methods, outputs, and information.[162] Peer review in the fields of science and engineering is a

> widely used, time-honored practice . . . for judging and potentially improving a scientific or technical plan, proposal, activity, program, or work product through documented critical evaluation by individuals or groups with relevant expertise who had no involvement in developing the object under review. Peer review seeks to assess and potentially to foster the improvement of scientific and technical methodology, evidence, criteria, assumptions, calculations, extrapolations, inferences, interpretations, and documentation.[163]

In the realm of scientific research, scientific peer review[164] has served as a method of "quality control"[165] and is "widely considered 'essential to the integrity of scientific and scholarly communication.'"[166] Peer review "is commonplace, indeed, fundamental, to the practice of science. It is the gold standard for determining publication and general acceptance of scientific research."[167]

The call for greater peer review is not a new one. Environmental scholars have for some time proposed adopting some form[168] of peer review as a means for improving agency regulatory decisionmaking. And, although the precise form and scope remains a matter of debate, a consensus exists for peer review of environmental regulatory action.[169] As but one

vironment to their conscious or subconscious outlooks or predispositions and ignore or distort the external environment partially and selectively" and this "leads to chronic misperception of events and processes." *Id.* at 24. Not only are people selectively attentive, but they are "'predisposed to complete acts in ways that are perceived to leave the actor better off than if he had completed them differently.'" *Id.* (quoting H.D. Lasswell, A Pre-view of Policy Sciences 16 (1971) (defining policy sciences "maximization postulate")).

160. *See* Hallinan, *supra* note 152, at 64–65 (2009). In one example, as many as 29% of American college students who were asked about their high school grades not only recalled their grades incorrectly, but recalled them as better than they actually were. Of the 99 students in the study, 79 inflated their grades. *Id.* at 58.

161. To be clear, nothing in this Article advocates a do nothing approach. The fact that we err does not mean we should not or cannot regulate for society's benefit. Rather, the issue is how best to regulate given the certainty that we will err.

162. *See* J.B. Ruhl & James Salzman, *In Defense of Regulatory Peer Review*, 38 Envtl. L. Rep. (Envtl. Law Inst.) 10,553, 10,554 (Aug. 2008).

163. Comm. on Research and Peer Review in Envtl. Prot. Agency, Bd. on Envtl. Studies in Toxicology, Nat'l Research Council, Strengthening Science at the U.S. Environmental Protection agency: Research-Management and Peer-Review Practices 99 (2000) [hereinafter Strengthening Science at the EPA] (internal citations omitted).

164. Professors Ruhl and Salzman define "scientific peer review" as "a rigorous review and critique of a study's methods, results, and finding that is conducted by others in the relevant field who have the requisite training and expertise, who have no pecuniary or other disqualifying bias with respect to the topic, and who are independent of the persons who performed the study." Ruhl & Salzman, *supra* note 162, at 10,554; *see also* Louis J. Virelli III, *Scientific Peer Review and Administrative Legitimacy*, 61 Admin. L. Rev. 723, 733 (2009) (defining "traditional" peer review as "a nonbinding, critical, objective analysis by one or more independent experts in the field of a project's novelty, methods, rationality, and contribution to scientific knowledge"); U.S. Gen. Accounting Office, GAO/RCED-99-99, Federal Research: Peer Review Practices at Federal Science Agencies Varies 2 (1999) [hereinafter Federal Research: Peer Review Practices] ("Officials at the Office of Science and Technology Policy and at the agencies … generally concur that peer review is defined as a process that includes an independent assessment of the technical, scientific merit of research by peers who are scientists with knowledge and expertise equal to that of the researchers whose work they review.").

165. *See* Ruhl & Salzman, *supra* note 162, at 10,558 (peer review is "quality control, not quantity control").

166. *See id.* at 10,555 (quoting Ann C. Weller, Editorial Peer Review: Its Strengths and Weaknesses 322 (2001)); *see also* Federal Research: Peer Review Practices, *supra* note 164, at 1 ("To help ensure the quality and integrity of [federal] research, U.S. science has traditionally relied on independent reviews by peers.").

167. *See* Ruhl & Salzman, *supra* note 162, at 10,554.

168. For a comparison and evaluation of three different peer review models applicable to administrative agency decisionmaking, *see* Virelli, *supra* note 164, at 745–48 (setting out the binding and nonbinding consultative, the commentator, and the decisionmaker models of peer review).

169. *See id.* at 739 ("The wisdom of relying on some measure of administrative peer review in policymaking has been largely uncontroversial" and "the general consensus is … that peer review, understood for what it is, does more good than harm."); *see also* Rick E. Melberth & Gary D. Bass, *Comment on in Defense of Regulatory Peer Review*, 38 Envtl. L. Rep. (Envtl. Law Inst.) 10,561 (August

example, Professors Ruhl and Salzman have proposed the application of a form of "regulatory peer review" that would institutionalize randomized outside evaluations of agency "compilation, selection, or use of scientific data" when used in support of proposed regulatory decisions.[170] Although they identify various upsides[171] and downsides[172] of increasing agency peer review, one benefit would be the reduction of institutional and personal bias. Additionally, peer review would improve the accuracy of agency interpretation and employment of research results.[173]

Carefully crafted peer review can serve as a useful check on agency science by anticipating, expecting, searching for, catching, or deterring[174] scientific errors in advance of agency action based on such science. Because peer review presupposes that agency science will at times be flawed, inaccurate, or inept, it offers a means for safeguarding against our tendencies toward hubris.[175] Peer review is a more humble approach to regulatory decisionmaking.

Nevertheless, to date, environmental regulatory agencies have not embraced peer review to the same extent as the scientific research community.[176] This is not to say that regulatory peer review at federal environmental agencies is without precedent. EPA, for example, has had peer review policies in place for more than a decade.[177] Moreover, according to the Government Accountability Office, formerly the General Accounting Office ("GAO"), in addition to some peer review,

> most agencies . . . conduct various types of internal reviews as checks on the quality of their research. These reviews are generally conducted by supervisors or managers and are, therefore, not independent reviews of the research. Agencies conduct these quality assurance reviews to assess the merit of proposed research, to assess the progress of on-going research, and to evaluate research results. These reviews occur at both the project and program level.[178]

The National Research Council ("NRC"), however, has long urged EPA to more fully embrace peer review asserting that EPA's efforts have been neither neutrally applied, nor wholeheartedly accepted.[179] According to a 2001 report by the NRC,

> EPA has made excellent progress in expanding and strengthening its peer-review practices, but the agency should find a way to ensure a greater degree of independence in the management of its peer reviews. . . . [I]ndependence is essential to the proper and credible functioning of the peer-review process, and EPA's current policies fail to ensure adequate independence. Our committee shares the SAB's [Science Advisory Board] concern about the potential for conflicts of interest of EPA peer-review leaders and decision-makers.[180]

NRC emphasized that "peer review must become accepted throughout EPA as a part of the agency's culture—a tool for improving quality—not merely a bureaucratic requirement."[181] In short, peer review needs to become more than a mere regulatory afterthought—it must become part of the regulatory mindset.

2. Additional Strategies

Regulators need not rely solely on enhanced peer review to escape the dangers of hubristic regulation. Regulators can also better catch, avoid, minimize, or deter regulatory errors in advance of regulatory decisionmaking by improving informational systems,[182] implementing probabilities analyses,[183] enhancing governmental coordination,[184] and

2008) ("It hardly seems controversial to suggest that research used for regulatory decision-making be peer-reviewed, but the devil is always in the details."); Ruhl & Salzman, *supra* note 162, at 10,554 (practitioner support for peer review).

170. Ruhl & Salzman, *supra* note 162, at 10,554.

171. Identified advantages of regulatory peer review include: informing the public of to the true basis of agency decisions (for example, science verses policy); improving the quality of regulatory decisions; and enhancing the legitimacy of the regulatory process. *See id.* at 10,555.

172. Identified disadvantages of regulatory peer review include: exacerbation of institutional biases; added agency research burdens (without improved quality of research conducted); "paralysis by analysis;" and interference with agency policy deliberations. *See id.* at 10,558–60. For further discussion on the limitations of peer review *see* Strengthening Science at the EPA, *supra* note 163, at 100–01.

173. *See* Ruhl & Salzman, *supra* note 162, at 10,555.

174. *See id.* at 10,559 (suggesting random peer review audits will deter poor science).

175. Random peer review audits would additionally allow feedback for whether and where peer review would work best. Thus their proposal also has a post-decisional bang. *See id.* at 10,555.

176. *See id.* at 10,555 (Peer review is "neither mandated by most environmental laws nor required through the default administrative law doctrines of the APA"); Federal Research: Peer Review Practices, *supra* note 164, at 2 ("There is no uniform federal policy for conducting peer reviews.").

177. *See* Envtl. Prot. Agency, The State of Sound Science at the U.S. Environmental Protection Agency 4 (2003) (peer review policies in place since 1993).

178. Federal Research: Peer Review Practices, *supra* note 164, at 9.

179. *See* Strengthening Science at the EPA, *supra* note 163, at 19–20.

180. *Id.* at 20–21; *see also* U.S. Gen. Accounting Office, GAO-01-536, EPA's Science Advisory Board Panels: Improved Policies and Procedures Needed to Ensure Independence and Balance 2 (2001) ("The policies and procedures developed by the staff office to ensure the independence of the Board's peer reviewers and the balancing of viewpoints represented on each panel have limitations that reduce their effectiveness").

181. *See* Strengthening Science at the EPA, *supra* note 163, at 21 (recommending "periodic dissemination of the impacts and benefits of completed reviews" to foster cultural change at EPA).

182. *See* Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 Emory L. J. 1, 65 (2009) (calling for improved intergovernmental information sharing); Craig, *supra* note 14, at 40–42 (2010) (calling for more "requirements and funding for continual monitoring and basic scientific and economic research to promote understanding of climate change impacts at all scales and across all sectors" to "help policymakers avoid overly simplistic 'solutions' to, and panaceas for, climate change adaptation."); *see, e.g.*, Bradley C. Karkkainen, *Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?*, 89 Geo. L.J. 257, 283–86 (2001) (discussing deficiencies of environmental information policy).

183. *See* Dave Owen, *Probabilities, Planning Failures, and Environmental Law*, 84 Tul. L. Rev. 265, 265 (2009) (proposing reforms to "reduce the frequency of plan failure").

184. *See* Craig, *supra* note 14, at 54 (calling for coordinated and integrated planning efforts in response to climate change in order to "reduce redundancies, increase efficiency, and avoid conflicting adaptation measures"); Camacho, *supra* note 182, at 64–65 (advancing idea of a "collaborative network" for managing regulatory error due to climate change uncertainty).

facilitating public scrutiny.[185] One informational strategy advanced to address climate change is creation of a climate change "clearinghouse."[186] Responding to the concern that regulator and resource manager errors "may be inevitable," the clearinghouse strategy is offered to foster information sharing and thereby improve regulatory learning.[187] Another approach, acknowledging that regulatory planning efforts can and do fail, suggests that regulators adopt "generally applicable standards for the probability of plan success" to reduce such decisional errors.[188] Although this approach is primarily concerned with errors associated with uncertainty, the approach would also seemingly apply in situations where regulator overconfidence in low-probability actions also leads to plan failure.[189] Environmental regulators might also consider error reduction efforts employed by professionals in other fields, such as the use of error prevention checklists.[190] Although checklists already play a role in some environmental programs,[191] perhaps a larger role exists for this tool as regulator error reduction strategy.

B. Post-Decision Feedback Loops

Another set of options for integrating greater humility into environmental regulation relies on post-decisionmaking, or back-end, strategies. Specifically, environmental law could take greater advantage of feedback mechanisms that force regulators to continuously reassess, retain, tweak, modify, or entirely scrap erroneous or obsolete environmental program designs or permitting assumptions. Taking to heart the aphorism attributed to James Joyce that "a man's errors are his portals of discovery," feedback mechanisms can serve to institutionalize the common sense proposition that we should learn from our mistakes. Essentially, if regulators are bound to err, environmental law should at least strive to catch, fix, and learn from these mistakes as quickly as possible.[192]

Feedback is a signal.[193] Feedback provides information about what "action has actually been done and what result has been accomplished" in a manner that can shape human behavior.[194] Several approaches—previously and persuasively advocated by academics, scientists and environmental organizations—might be recruited for introducing feedback mechanisms into environmental law. Two examples are adaptive management and post-decision reassessment pursuant to National Environmental Policy Act ("NEPA")[195] review. Both are discussed below.

1. Adaptive Management

Adaptive management is an "iterative, incremental decisionmaking process built around a continuous process of monitoring the effects of decisions and adjusting decisions accordingly."[196] It applies "monitoring-adjustment frameworks" so that new information "can be fed back into the ongoing regulatory process."[197] At its core, "'adaptive management consists of managing according to a plan by which decisions are made and modified as a function of what is known and learned about the system, including information about the effect of previous management actions.'"[198] Adaptive management requires continuous information collection to catch and correct regulatory errors on an ongoing basis.[199]

Many academics recognize ecologist C.S. Holling as the principal pioneer of adaptive management.[200] Appar-

185. *See* Holly Doremus, *Listing Decisions under the Endangered Species Act: Why Better Science Isn't Always Better Policy*, 75 Wash. U. L. Q. 1029, 1151 (1997) ("[P]ublic scrutiny is the most effective weapon against careless or biased decisionmaking."); Marc B. Mihaly, *Citizen Participation in the Making of Environmental Decisions: Evolving Obstacles and Potential Solutions through Partnerships with Experts and Agents,* 27 Pace Envtl. L. Rev. 151, 160–61 (2009–10) (asserting that "insider staff and officials frequently need outsider citizen input to make them wise" and noting that "[f]or every horror story of unintelligent, parochial citizen input, other stories show that such input forces information on staff and decision-makers who would not have faced it otherwise, because they were simply unaware, because they were pressured not to see, or because the information contravened their own ideologies."); *cf.* Zygmunt J. B. Plater, *Dealing with Dumb and Dumber: The Continuing Mission of Citizen Environmentalism*, 20 J. Envtl. L. & Litig. 9 (2005) (identifying five categories of "dumb" within U.S. environmental protection policy).

186. Camacho, *supra* note 182 at 64–70.

187. *See id. at* 64–65.

188. Owen, *supra* note 183, at 272–73.

189. *See id.*

190. Recent error reduction efforts in healthcare have focused on the use of checklists to reduce medical care errors. *See* Edward H. Livingston, *Solutions for Improving Patient Safety*, 303 J. Am. Med. Ass'n 159–61 (2010); Alex B. Haynes et al., *A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population*, 360 New Eng. J. Med. 491 (2009); Brigette M. Hales & Peter J. Pronovost, *The Checklist—A Tool for Error Management and Performance Improvement*, 21 J. Critical Care 231 (2006); 21 J. of Critical Care 231-235 (2006). The aviation field has long used similar error management strategies. *See* Daniel Boorman, *Today's Electronic Checklists Reduce Likelihood of Crew Errors and Help Prevent Mishaps*, Int'l Civil Aviation Org. J. (Jan. 2001), at 17–20, 36.

191. *See, e.g.*, U.S. Gen. Servs. Admin., NEPA Desk Guide 5-5 (1999) (requiring NEPA Regional Environmental Quality Advisors to maintain a Categorical Exception checklist to help "consider the possible environmental consequences of Checklist [Categorical Exception] actions.").

192. *See* Hallinan, *supra* note 152, at 158 ("[O]ne of the best cures for overconfidence: quick, corrective feedback"); *see also* Christopher Mausolff, *Learning from Feedback in Performance Measurement Systems*, 28 Pub. Performance & Mgmt. Rev. 9 (2004) ("Feedback is central to learning.").

193. *See* Hallinan, *supra* note 152, at 158.

194. *Id.*

195. National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321–4347 (2006). NEPA does not currently provide for post-decision review; however, academics have argued for such reform.

196. J.B. Ruhl, *Regulation by Adaptive Management—Is It Possible?*, 7 Minn. J. L. Sci. & Tech. 21, 28 (2005).

197. *Id.* at 30. *But see* Bradley C. Karkkainen, *Panarchy and Adaptive Change: Around the Loop and Back Again*, 7 Minn. J. L. Sci. & Tech. 59, 70–71 (2005) (distinguishing between "active" and "passive" adaptive management and characterizing Ruhl's formulation as the less scientifically rigorous, less experimental, passive formulation).

198. Holly Doremus, *Adaptive Management, the Endangered Species Act, and the Institutional Challenges of "New Age" Environmental Protection*, 4 Washburn L.J. 50, 52 (2001) (quoting Ana M. Parma et al., *What Can Adaptive Management Do for Our Fish, Forests, Food, and Biodiversity?,* 1 Integrative Biology 16, 19 (1998)).

199. *See* Ruhl, *supra* note 196, at 30 ("Deliberate monitoring and a framework for altering course, rapidly and frequently if conditions warrant, thus are essential ingredients of adaptive management.").

200. *See* Ruhl, *supra* note 196, at 28 ("Today's voluminous literature on adaptive management traces its roots to Professor C.S. Hilling's seminal work, Adaptive Environmental Assessment and Management."); Karkkainen, *supra* note 197, at 59 (citing C.S. Holling, *Preface* to Adaptive Environmental Assessment and Management, at xv–xviii (C.S. Holling ed., 1978); Mary Jane Angelo, *Harnessing the Power of Science in Environmental Law: Why We Should, Why We Don't, and How We Can*, 86 Texas L.R. 1527, 1547 (2008)). Others deserve credit along with Holling. Holling collaborated with Carl Walters at the University of British Columbia in developing the initial concept of AEAM in the

ently frustrated by the scientific status quo, Holling sought to transform the process of environmental assessment from a one-time, pre-decisional (front-end) analysis to an ongoing, pre- and post-decisional (front- and back-end) scientific inquiry.[201] In Holling's conception, adaptive management begins with teams of scientists constructing models using the best currently available science, identifying information gaps and uncertainties, and generating testable hypotheses regarding identified gaps and uncertainties.[202] Next,

> [w]orking with managers, the scientists . . . design management interventions as scientific experiments carefully tailored to field-test their hypotheses against observed outcomes. The results of these 'adaptive management' experiments would feed back into further refinements of the ecological models, generating subsequent rounds of testable hypotheses."[203]

Holling considered his concept to be "a scientifically defensible, learning-by-doing, incremental and iterative approach to improving our understanding of complex ecosystems,"[204] and he believed adaptive management would lead to continual improvements in scientific understanding, decisionmaking,[205] and "our ability to manage environmental problems in their proper ecological context."[206] Indeed, many agree.[207]

Adaptive management stands as a natural countermeasure to overconfident environmental decisionmaking.

At its core, adaptive management presumes we do not, cannot, and will never know everything, and so we are bound to err.[208] Holling's "learning by doing" approach operates on the principle that there will always be something more to learn after a regulatory decision is made. Thus, adaptive management is inherently humble. At the same time, Holling believed we might counteract initial decisional deficiencies by actively and continuously checking and modifying initial assumptions—by adapting to errors as we go. In this way, adaptive management retains a modest, practical confidence for achieving better outcomes. In presuming errors of implementation as part of the decisionmaking process and by insisting on perpetual reassessment and ongoing corrective measures, adaptive management can thwart, or at least frustrate,[209] errors of arrogant, overconfident decisionmaking. For all these reasons, adaptive management may be particularly useful in addressing global climate change.[210]

Nevertheless, implementation of adaptive management, while theoretically wise, remains practically challenging.[211] Despite much scientific and legal literature extolling its virtues, adaptive management currently plays only a limited role in environmental law.[212] Identified barriers to implementation include resource constraints,[213] agency dysfunction and resistance,[214] political gerrymandering,[215] and a fundamental incompatibility with existing legal institutions.[216] Nevertheless, despite these barriers, many legal scholars, scientists and regulators remain committed to the

1980s, and a similar concept may be found in Charles E. Lindblom's work, *The Science of "Muddling Through,"* published in 1959. *See* Mary Jane Angelo, *Harnessing the Power of Science in Environmental Law: Why We Should, Why We Don't, and How We Can*, 86 Texas L.R. 1527, 1547 (2008).

201. *See* Karkkainen, *supra* note 197, at 59–60; *see also* Ruhl, *supra* note 196, at 30 (discussing front end/back end decisionmaking).
202. *See* Karkkainen, *supra* note 197, at 60.
203. *Id.* at 60–61.
204. *Id.* at 59.
205. *Id.* at 61.
206. *Id.* at 59.
207. *See* Ruhl, *supra* note 196, at 28, 31 n.21 ("[I]t is almost universally the case that advocates of regulatory innovations also advance the method of implementation known generally as *adaptive management*," and "support for adaptive management is legion and literature on implementation theory abounds.").
208. *See* Doremus, *supra* note 198, at 53 ("The basic premise of adaptive management is that we do not know enough to be confident that our management decisions will achieve the desired results.").
209. *See id.* ("Adaptive management can help us recognize management mistakes and limit the damage they cause by modifying or correcting them expeditiously. But it does not prevent mistakes, nor does it guarantee that the mistakes we make will be reversible."). Professor Doremus rightly warns that "[w]e should resist the temptation to believe that instituting a program of adaptive management will, by itself, immunize the resource from harm." *Id.*
210. *See* Craig, *supra* note 14, at 65–67 (climate change adaptation is "the quintessential adaptive management problem, and both scientists and governments (at all levels) have acknowledged that adaptive management is a necessary approach to climate change adaptation.").
211. *See* Ahjond S. Garmestani et al., *Panarchy, Adaptive Management and Governance: Policy Options for Building Resilience*, 87 Neb. L. Rev. 1036, 1045–46 (2009) ("Adopting adaptive management may be an agency's dream; practicing it is a nightmare.").
212. Angelo, *supra* note 200, at 1552 ("Although often proposed as a needed component of environmental regulation, adaptive management has not yet been integrated into environmental regulatory programs"). *See also* Doremus, *supra* note 198, at 54 ("Within the natural resource management community, there is both great enthusiasm about the potential of adaptive management . . . and great skepticism about our practical ability to implement it effectively."); Ruhl, *supra* note 196, at 31 n.21 ("[A]lthough support for adaptive management is legion and literature on implementation theory abounds, from what I can tell very few commentators from science or law are asking whether it can succeed in the conventional administrative law system.").
213. *See* Doremus, *supra* note 198, at 53 (identifying time and resource constraints as potential barriers).
214. Professor Doremus identifies at least two such agency dysfunction barriers. For one, regulators and scientists restrained and controlled by personal and institutional biases may misinterpret, resist, reject, or inappropriately respond to new information. *Id.* at 55–56. Darker yet, "[a]gencies can use claims of adaptive management as a ploy" to avoid regulating or "as a smokescreen to conceal political accommodations." *Id.* at 53, 88; *see also* Angelo, *supra* note 200, at 1559 (noting that adoption of adaptive management is inconsistent with agency preference for simple rather than complex regulatory approaches); Ruhl, *supra* note 196, at 36 (discussing GAO report identifying "cultural resistance" as a barrier to the adoption of alternative management approaches); Craig, *supra* note 14, at 17–18 (advocating notion of "principled flexibility" as a contraint on unbridled regulatory discretion).
215. *See* Angelo, *supra* note 200, at 1565 (identifying "politicization of science" as factor limiting adoption of adaptive management); Doremus, *supra* note 198 at 56 ("Leaving management decisions open in order to allow adaptive response to new information necessarily leaves those decisions subject to political pressures that may inhibit biologically rational response.").
216. *See* Doremus, *supra* note 198, at 54 n.18 (Noting "[i]nstitutional structures and arrangements, in particular, have repeatedly been fingered as key impediments to realizing the promise of adaptive management" and citing numerous scientific literature sources in support)*; see also* Angelo, *supra* note 200, at 1548 (quoting Timothy H. Profeta, *Managing Without a Balance: Environmental Regulation in Light of Ecological Advances*, 7 Duke Envtl. L. Pol'y F. 71, 71 (1996) ("environmental regulation that can provide 'feedback loops to update regulatory efforts as information increases' is 'counterintuitive for the American legal system, which puts a premium on firm rules of law.'")); Ruhl, *supra* note 196, at 31 (specifically targeting administrative law: "there is good reason to doubt whether regulation by adaptive management is possible without substantial change in administrative law").

value,[217] need,[218] workability,[219] and inevitability[220] of adaptive management.

An additional barrier, though less significant, deserves mention. Adaptive management, as originally conceived and designed, focuses on problems of uncertainty.[221] It is a process for exploring, testing, and refining knowledge gaps and model *uncertainties*. However, the fundamental problem of arrogant decisionmaking is regulator allegiance to false *certainties*. To counter regulatory certitude, we need options for exploring, testing, and refining not what regulators consider uncertain, but what they believe with certainty. At least superficially, the problem (misplaced certainty) and the purported solution (reducing uncertainty) do not match up.

On closer examination, however, this problem-solution misalignment fails to undercut the utility of adaptive management as a countermeasure to regulatory hubris. First, even in its current design, adaptive management allows for identification and rectification of mistakes from hubristic decisions. The learning associated with adaptive management approaches encompasses more than mere gap filling; it holds the potential for incremental, episodic, and even transformational learning.[222] Even the least potent, most basic form of these learning types—incremental learning—allows for identification of regulatory errors based on initial assumptions.[223] Second, on a theoretical level, regulators can apply adaptive management to test and assess certainties along with uncertainties.[224] Third, and of most value, adaptive management offers a transformative mindset to arrogant environmental decisionmaking. In acknowledging and embracing human error as a fundamental component of the regulatory process, adaptive management offers a counterbalance to errors of certitude.

2. Enhanced Environmental Review

A fundamental goal of NEPA is the encouragement of environmentally informed decisionmaking.[225] Although judicially interpreted as procedural in nature,[226] federal decisionmakers must fully consider[227] the final environmental statement before moving forward.[228] Essentially, the ultimate goal of NEPA's front-end process is to "nip in the bud the detrimen-

217. Angelo, *supra* note 200, at 1552 (adaptive management has "proven to be an effective approach" for complex ecosystem management).

218. *See* Doremus, *supra* note 198 at 51–52 (adaptive management is "essential to the ultimate success of" new age environmental restoration efforts); Karkkainen, *supra* note 197, at 61 ("many leading scientists and natural resource management professionals now see the need for some form of adaptive management as axiomatic"); Ruhl, *supra* note 196, at 33–34 ("In the long run, however, the need to use adaptive approaches will not diminish—if anything, it will only increase.").

219. *See* Doremus, *supra* note 198, at 89 ("At the moment, our institutions seem ill suited to that task, but there are corrective steps we can take.").

220. *See* Ruhl, *supra* note 196, at 34 ("As gloomy as the prospects for adaptive management appear today, regulation by adaptive management is *inevitable*.").

221. Holling's approach to environmental assessment called for field testable hypotheses "designed to fill the gaps and reduce the uncertainties" in management models. Karkkainen, *supra* note 197, at 60. Holling's collaborator, Carl Walters, similarly considered adaptive management as "a way to deal with scientific uncertainty" inherent in resource management. Angelo, *supra* note 200, at 1547; *see also* Sandra Zellmer & Lance Gunderson, *Why Resilience May Not Always be a Good Thing: Lessons in Ecosystem Restoration From Glen Canyon and the Everglades,* 87 Neb. L. Rev. 893, 911 (2009) (discussion of adaptive management as a strategy to deal with uncertainty).

222. *See* Garmestani et al., *supra* note 211, at 1043 (categorizing adaptive management learning types). In their article, Garmestani, Allen, and Cabezas describe these three types of learning as follows:

> **Incremental learning** occurs as plans, models, and policies are implemented and evaluated. Models or schemas are assumed to be correct, and learning is characterized by collecting data or information to update those models. In bureaucratically dominated resource systems, the learning is carried out largely by self-referential professionals or technocrats, who view dealing with this type of change and learning mainly as problem solving. Passive forms of adaptive management promise this type of learning.
>
> **Episodic learning** is discontinuous in time and space. It can be generated by ecological regime shifts that reveal the inadequacies of the underlying models or policies. This type of learning occurs after environmental crises in which policy failure is undeniable. In this case, the learning is described as double-loop, in which the underlying model or schema is questioned and rejected. This is also characterized as problem reformation. In bureaucratic resource systems, this type of learning is facilitated by outside groups or charismatic integrators.
>
> **Transformational learning** is the most profound form of learning. Cross-scale surprises or the emergence of novelty characterize this type of change. In these cases, learning requires the reframing of problem domains. Transformational learning involves several levels in a social-ecological panarchy, not simply one level of a social system responding to ecological surprises.

Id. (emphasis added).

223. *See id.* (discussing "incremental" learning associated with adaptive management).

224. As a practical matter resource constraints may limit the scope of adaptive management testing and assessment. *See* Doremus, *supra* note 198, at 53 (time and resource constraints as potential barriers). However, this does not mean the approach cannot be used to detect errors of certainty. *Id.*

225. *See* David R. Hodas, *NEPA, Ecosystem Management and Environmental Accounting*, 14 Nat. Resources & Env't 185, 185 (2000) ("Predicated on the idea that governmental decisions should not be made without full consideration of adverse environmental implications of the decisions, NEPA suggests that the more environmentally realistic our expectations, the greater the opportunity to reduce poverty, increase wealth, and diminish environmental degradation."); Douglas A. Kysar & James Salzman, *Forward: Making Sense of Information for Environmental Protection*, 86 Tex. L. Rev. 1347, 1354 (2008) ("Merely by forcing the compilation of environmental-impact information and prompting its consideration in some unspecified but nontrivial way, NEPA was supposed to transform governmental decision making."). Along with academics, both regulators and courts have recognized and acknowledged NEPA's informed decisionmaking goal. *See* 40 C.F.R. § 1500.1(b) (2011) (stating environmental information must be provided to "public officials and citizens before decisions are made and before actions are taken"); 40 C.F.R. § 1502.1 (2011) (EIS "shall inform decisionmakers" and be used by Federal officials to "make decisions"); *see also* Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 349 (1989) (NEPA's EIS requirement serves to ensure that the agency "in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts"); Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 508 F.3d 508, 517 (9th Cir. 2007).

226. The statute is procedural in the sense that so long as an EIS is prepared and considered, NEPA does not mandate any particular result; the agency may choose to go forward with its preferred action regardless of identified environmental impacts or less damaging alternatives. *See Robertson*, 490 U.S. at 350; Strycker's Bay Neighborhood Council, Inc. v. Karlen, 444 U.S. 223, 227 (1980) (quoting Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 558 (1978)).

227. *See* Grand Canyon Trust v. FAA, 290 F.3d 339, 340–41 (D.C. Cir. 2002) (agency "hard look" required for environmental assessments); *Ctr. for Biological Diversity*, 508 F.3d at 526 (quoting Or. Natural Res. Council v. Lowe, 109 F.3d 521, 526 (9th Cir. 1997)) (with respect to NEPA documents, agency must take a "hard look" at the impacts of its action); *see also* Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 416 (1971) (judicial review requires a "searching and careful" inquiry into agency decisions). *See generally* Daniel R. Mandelker, NEPA law and Litigation §§ 3:7, 8:13 (2010) (discussing "hard look" doctrine).

228. Calvert Cliffs Coordinating Comm. v. U.S. Atomic Energy Comm'n, 449 F.2d 1109, 1114–15 (D.C. Cir. 1971).

tal effects of human activities on the environment."[229] As it stands, however, NEPA mandates only pre-decisional agency consideration of identified environmental impacts and little more.[230] It is this strictly front-end predictive analysis that many identify as NEPA's "fatal flaw."[231]

According to Professor Karkkainen, "NEPA ambitiously, and naively, demands the impossible: comprehensive, synoptic rationality, in the form of an exhaustive, one-shot set of *ex ante predictions* of expected environmental impacts"[232] while in practice "[t]he agency's predictions . . . may be predicated upon faulty or incomplete baseline data, incomplete or inconclusive science, or simple misjudgments about the direction and magnitude of change in complex, nonlinear, dynamic, and interdependent ecological settings."[233] These flaws, in turn, reflect a larger, problem: "statutory and regulatory frameworks predicated upon outdated and erroneous mid-twentieth-century assumptions about the ease of acquiring and processing the information required for sound environmental decision making."[234]

Professor Hodas pinpoints NEPA's fundamental structural defect: "No [a]fter-the-fact [r]esponsibility for [e]rrors."[235] According to Hodas,

> [t]his fundamental defect is the little-appreciated fact that no one is responsible for substantive errors, flaws or inadequacies in EIS evaluations. So long as the NEPA process has been followed, there is no consequence to the decisionmaker for making a bad decision, short of fraud, nor is there even any obligation to follow up on the project to see what are the actual adverse environmental consequences.[236]

Implicit in both the Hodas and Karkkainen arguments is the notion that NEPA, as adopted by the legislature and interpreted by the courts, fails to address or even acknowledge the inevitability of regulatory error.[237] NEPA presumes regulators can and will fully, correctly, and unfailingly identify all of the significant environmental impacts of agency actions before the actions are taken. And, whether deliberately or unwittingly, herein lies the hubris of the NEPA architects: NEPA presumes regulatory infallibility. NEPA offers no meaningful provisions for discovering and correcting decisional errors based on erroneous information or mistaken predictions because none are anticipated, or they are of too little consequence to need addressing. In fact, however, NEPA predictions "often turn out to be wrong,"[238] and in some cases terribly wrong.[239]

As with the prior appeals for enhanced peer review and adaptive management, the call for back-end NEPA enhancements is not a new one. Proposals for giving NEPA post-decisional pluck have come from various sources. Significantly, however, the NEPA proposals share a common core—a less arrogant, more humble conception of environmental law—that is, they all explicitly acknowledge the possibility and inevitability of regulatory error. For example, Professor Karkkainen offers up a detailed series of post-decisional NEPA reforms ("[s]ystemic monitoring, continuous information feedback, and adaptive decisionmaking mechanisms"[240]) to counter identified NEPA pathologies (e.g., reliance on unattainable clairvoyance, inevitable pre-decisional errors, and interjection of false confidence in predictive judgments[241]) and to transform NEPA into a "'learn as you go,'" "'smart,' pragmatic, and experimental environmental management tool"[242] for regulatory decisionmaking.

Similarly, in 2010, the year of NEPA's fortieth anniversary, the Council on Environmental Quality ("CEQ") issued draft guidance advocating post-decisional NEPA strategies.[243] The CEQ memorandum entitled "Draft Guidance for NEPA Mitigation and Monitoring" ("CEQ Draft Guidance") calls on all federal implementing agencies to (1) consider mitigation "throughout the NEPA process," (2) create monitoring programs that "ensure mitigation measures are implemented and effective," and (3) allow public access to mitigation monitoring information.[244] The CEQ Draft Guidance implicitly acknowledges the occasion of initial, pre-decisional regulatory error by noting that federal actions occur in an evolving, non-static decisionmaking context where monitoring can "improve the quality of overall agency decisionmak-

229. Madeline J. Kass, *A NEPA Climate Paradox: Taking Greenhouse Gases into Account in Threshold Significance Determinations,* 42 Ind. L. Rev. 47, 51 (2009); *see also* Council on Envtl. Quality, Considering Cumulative Effects Under the National Environmental Policy Act 46 (1997).

230. Bradley C. Karkkainen, *Toward a Smarter NEPA: Monitoring and Managing Government's Environmental Performance*, 102 Colum. L. Rev. 903, 925–26 (2002) [hereinafter *Toward a Smarter NEPA*] ("NEPA demands that the agency conduct a single, exhaustive, panoptic, and purely predictive information production exercise prior to undertaking action.").

231. *Id.* at 903–04 ("fatal flaw"); *see also* David R. Hodas, *The Role of Law in Defining Sustainable Development: NEPA Reconsidered*, 3 Widener L. Symp. J. 1, 45 (1998).

232. *Toward a Smarter NEPA, supra* note 230, at 906.

233. Bradley C. Karkkainen, *Bottlenecks and Baselines: Tackling Information Deficits in Environmental Regulation*, 86 Tex. L. Rev. 1409, 1410–11 (2008) [hereinafter *Bottlenecks and Baselines*].

234. *Id.* at 411.

235. Hodas, *supra* note 231, at 45–48. Professor Hodas identifies a number of other flaws, including judicial mis-interpretation, narrowing, and weakening of NEPA's legislative mandate. *See id.* at 37–45.

236. *Id.* at 45 (explaining that as a consequence, this structural defect can contribute, and has contributed, to "terrible consequences").

237. *See Toward a Smarter NEPA*, *supra* note 230, at 926–27 (One problem of a "one-time-only, predictive approach" is that "predictions often turn out to be wrong," and given the complexity and dynamic characteristics of ecosystems and environmental processes, accurately predicting all project impacts is essentially impossible); *Bottlenecks and Baselines*, *supra* note 233, at 1410 ("If the agency turns out to be wrong, we will never even know it . . . "); Hodas, *supra* note 231, at 45–48.

238. *Toward a Smarter NEPA*, *supra* note 230, at 926–28 (discussing empirical studies and regulatory mistakes); *see also Bottlenecks and Baselines*, *supra* note 233, at 1409–10 (available empirical studies suggest "where subsequent monitoring does allow verification of more precise predictions, the principal conclusions are wrong even about the direction of environmental change in a disturbingly large percentage of cases, and wrong about its magnitude in large part of the rest").

239. Hodas, *supra* note 231, at 45. Professor Hodas offers the Grand Teton Dam collapse as one such tragic example. After regulators mistakenly determined that a dam collapse was too remote a possibility to mention in the EIS, the dam did collapse killing eleven people, leaving 25,000 people homeless, and causing about a billion dollars in damages. *Id.*

240. *Toward a Smarter NEPA*, *supra* note 230, at 970.

241. *Id.* at 929–32 (discussing NEPA pathologies).

242. *Id.* at 970, 972. Other academics have offered up similar prescriptions. *See, e.g.,* Alyson C. Flournoy et al., *Harnessing the Power of Information to Protect Our Public Natural Resource Legacy*, 86 Tex. L. Rev. 1575, 1590–1599 (2008).

243. Memorandum from the Council on Envtl. Quality on Draft Guidance for NEPA Mitigation and Monitoring to Heads of Fed. Departments and Agencies (Feb. 18, 2010), *available at* http://ceq.hss.doe.gov/current_developments/new_ceq_nepa_guidance.html.

244. *Id.* at 2.

ing by providing feedback on the effectiveness of mitigation techniques and commitments" and by asserting the overall need for "systemic accountability."[245] With respect specifically to mitigation, the CEQ explicitly admits to not only the possibility, but also the actuality of regulator error by directly addressing "mitigation failure" and the need for contingency measures:

> Mitigation commitments should be structured to include adaptive management in order to minimize the possibility of mitigation failure. However, if mitigation is not performed or *does not mitigate the effects as intended by the design*, the agency responsible should, based upon its expertise and judgment regarding any remaining Federal action and its environmental consequences, consider whether taking supplementary action is necessary. * * * A *substantial mitigation failure*, in either implementation or effectiveness, should trigger a response from the agency.[246]

Moreover, according to the CEQ, even if post-decisional analyses come too late for agency response to a specific activity, the information may still inform future NEPA review of future activities—in essence post-decisional monitoring can help regulators learn from their mistakes even where they cannot be corrected.[247] In a way, CEQ has bought in to Senator Al Franken's jovial, but sage advice: "Mistakes are a part of being human. Appreciate your mistakes for what they are: precious life lessons that can only be learned the hard way. Unless it's a fatal mistake, which, at least, others can learn from."[248]

Deviating in some respects from the prior examples, Professor Hodas offers his own set of post-decisional NEPA reforms. Hodas suggests regulatory modifications requiring "externality valuation and the posting of security for all NEPA decisions."[249] He also suggests statutory changes to allow "citizens to sue the government for failing to perform a nondiscretionary duty (e.g., failing to include specific, secured, measurable externality valuation criteria in an EIS and project approval)."[250] Professor Hodas' back-end proposals aim at holding agencies and regulated entities accountable for front-end regulatory oversights, errors, inaccuracies, underestimated effects, and other identified derelictions in NEPA pre-decisional analyses. In short, by imposing post-decisional consequences for errors, we can encourage greater upfront care and more attention to the past mistakes of others.

C. Humility as a Regulatory Mindset

Particular countermeasures are necessary, but insufficient. We need a collective, determined shift to a new regulatory mindset. The new mindset must accept and accede to the certainty of regulatory uncertainty, bias, imperfection, blunder, and occasional bungling. The new mindset must reject and shun the presuming and presupposing of human perfection, infallibility, and clairvoyance whether explicit, implicit, or couched as boundless faith in human ingenuity. The new mindset must be characterized more by humility and less by hubris. While the feasibility and efficacy of pre-decisional safeguards and post-decisional feedback strategies remains to be determined, all can be part of the new regulatory mindset. Regulatory mistakes are inevitable, unavoidable, and wasteful—squandering time, money, and the very planetary resources we seek to protect, at a cost to society as a whole. In the face of ongoing environmental exigencies—as well as the spectre of devastation from global climate change already on our doorstep[251]—we have little time to waste on false certitudes and hubris. We need environmental laws designed as ongoing learning experiments rather than a know-it-all exercises.

V. Some Humble Last Thoughts

The shift to a more humble, less hubristic regulatory mindset will incur resistance, as all paradigm shifts do. The most effective ways to implement peer review, feedback mechanisms, and other error reduction and learning strategies to improve regulatory decisionmaking remain to be tested and sorted. And yet, ideas are out there. A shift is underway. Many philosophers, scholars, scientists, and regulators, more experienced and expert than this author, have thought long and hard on how best to catch regulatory mistakes before they occur and how to learn from our inevitable errors when they occur. Strategies for taking into account human fallibility, rather than assuming human perfection, already exist. Discussions are ongoing. Now we must reshape our collective attitudes. We must consciously seek and encourage a humbler regulatory mindset. Undoubtedly, pre-decisional safeguards, post-decisional feedback mechanisms, and other learning strategies all have caveats and constraints, including cost burdens on agencies and regulated entities of sustained regulatory oversight,[252] but some balancing of humble and hubris-based approaches is needed. We must regulate and legislate for the environment with greater humility—we are simply not wise enough to proceed otherwise.

245. *Id.* at 1–2.
246. *Id.* at 4.
247. *Id.*
248. Al Franken, Oh, the Things I Know! A Guide to Success, or, Failing That, Happiness 10 (2002).
249. *See* Hodas, *supra* note 231, at 59.
250. *See id.*
251. *See* Craig, *supra* note 14, at 70 ("The climate change era is upon us, and phenomena such as the changing Arctic tundra, expanding pine beetle infestations, and Montana's warming trout streams are harbingers of the growing need for effective adaptation strategies.").
252. *See, e.g.*, Dave Owen, *Probabilities, Planning Failures, and Environmental Law*, 84 Tul. L. Rev. 265, 333–34 (2009) (identifying the following challenges of post-decisional adaptive management: prohibitive cost associated with research, monitoring, and project alteration; timing constraints; agency institutional and cultural barriers to midcourse correction; and stakeholder marginalization).