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REDUCTIONIST REGULATORY REFORM

*Lisa Heinzerling**

With the American wilderness disappearing before our eyes, it is easy to forget that the chainsaw and the bulldozer are not the only threats our natural resources face. Wildlife, plants, indeed entire ecosystems must also contend with pollution. The effects of pollution on natural resources can be severe. Acid precipitation produced by the long-range transport of sulfur dioxide and nitrogen oxides has hurt forests, lakes, and streams.¹ Hormone-disrupting chemicals such as dioxin and DDT have been associated with widespread reproductive and other problems in birds, fish, and mammals.² Pesticides³ and ozone-depleting chemicals⁴ have been implicated in the alarming decline of the world's frogs. These and other ecological consequences quite obviously have more than one cause, but it seems safe to say that pollution is among them.

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1. For a concise history of the scientific studies linking sulfur dioxide and nitrogen oxides with damage to water bodies and forests, see John Harte, *Acid Rain*, in *THE ENERGY-ENVIRONMENT CONNECTION* 50 (Jack M. Hollander ed., 1992).

2. See Theo Colborn et al., *Developmental Effects of Endocrine-Disrupting Chemicals in Wildlife and Humans*, 101 *ENVTL. HEALTH PERSPECTIVES* 378, 378-79 (Oct. 1993). These effects are discussed at length in THEO COLBORN ET AL., *OUR STOLEN FUTURE* (1996).

3. For a discussion of research linking severe deformities in frogs in the Midwest and Canada in part to pesticides, see Tom Meersman, *Frog Research Puts Spotlight on Pesticides*, *STAR TRIB.* (Minneapolis-St. Paul), Feb. 16, 1997, at A1.

4. For the initial study finding an association between declining amphibian populations and increased UV-B radiation (itself attributable to ozone depletion caused by pollution), see A.R. Blaustein et al., *UV Repair and Resistance to Solar UV-B in Amphibian Eggs: A Link to Population Declines?*, 91 *PROC. NAT'L ACAD. SCI.* 1791 (Mar. 1, 1994). For criticism of this study based on its use of laboratory conditions rather than in situ testing, see Wade Roush, *When Rigor Meets Reality*, 269 *SCI.* 313 (July 21, 1995).

In recognition of these dangers, the express purpose of the laws regulating pollution in this country is the protection of human health and natural resources. Indeed, "protection of human health and the environment" appears like a mantra in virtually every one of our environmental laws.⁵ This statement of purposes recognizes that pollution harms not only people, but also other living things.⁶

This regulatory system is under attack. Critics have charged that the costs of many environmental regulations exceed their benefits; that many regulations are cost-ineffective, or that there are cheaper ways of achieving the same goals; that regulation sometimes *creates* risks; and that government does not engage in any sensible priority-setting.⁷ Each of these critiques has led to a prominent proposal for regulatory reform. Arguments that costs too often outweigh benefits and that current regulation is cost-

5. Clean Air Act, 42 U.S.C. §§ 7408-09,7602(h) (1996) (national ambient air quality standards to be set at level adequate to protect public health and welfare; "welfare" defined to include natural resources); Clean Water Act, 33 U.S.C. § 1313(c)(2)(A) (1997) (states' water quality standards must protect public health or welfare, and must take into account waters' "use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes"); Comprehensive Environmental Response, Liability, and Compensation Act, 42 U.S.C. § 9621(d)(1) (1997) (hazardous waste sites to be cleaned to level sufficient to assure "protection of human health and the environment"); Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. §§ 136(a), 136(bb) (1997) (pesticide registration may be denied or limited if necessary to prevent "unreasonable adverse effects on the environment," defined to include "any unreasonable risk to man or the environment"); Resource Conservation and Recovery Act, 42 U.S.C. § 6901 (1996) (purpose is to protect human health and the environment); Toxic Substances Control Act, 15 U.S.C. § 2601(a) (1995) (purpose is to protect human health and the environment).

6. For a persuasive argument that the Environmental Protection Agency should make better use of pollution control laws to protect biological diversity, or "those environmental goals that reach beyond human health concerns," see Robert L. Fischman, *Biological Diversity and Environmental Protection: Authorities to Reduce Risk*, 22 ENVTL. L. 435, 437 (1992).

7. For a lucid account of these critiques, see STEPHEN BREYER, *BREAKING THE VICIOUS CIRCLE: TOWARD EFFECTIVE RISK REGULATION* (1993).

ineffective have led, naturally enough, to calls for increased reliance on cost-benefit and cost-effectiveness analysis. Claims that regulation increases risks have supported demands for greater attention to risk tradeoffs. Complaints about the lack of priority-setting have led to calls for increased use of comparative risk assessment.⁸ These critiques and their corresponding reforms, long discussed in the academic literature, have recently arrived in political circles, most famously in the legislation accompanying the *Contract With America*.⁹

Despite their superficial differences, these critiques and their corresponding reforms share an important feature: they proceed as if the sole goal of environmental law were to protect human health. Critiques of the current regulatory system have made it appear outlandish and counterproductive partly by assuming that it has no purpose other than preventing premature human death. And, if the analysis required by the proposed reforms is to be kept to a manageable shape and size, then these reforms must embody the same reductionism.

In Part I of this essay, I review the reductionist tendencies of current critiques of environmental law. I then sketch how the proposals for regulatory reform that have followed from these critiques are also, in practice, likely to reflect a one-dimensional view of the purposes of environmental law. I conclude by describing how this reductionism will likely undermine the express and sensible purpose of virtually all of our environmental laws, which is to protect both humans and the other living things around us.

I. REDUCTIONIST CRITIQUES

The literature critical of existing environmental regulation is nearly as vast as the regulation itself, and I will not attempt to capture all of the details and nuances of the debate here. Certainly there are critiques that recognize that one important purpose of environmental law is to protect natural resources. Nevertheless, a substantial portion of the critical literature on

8. For a general discussion, see W. Kip Viscusi, *Regulating the Regulators*, 63 U. CHI. L. REV. 1423, 1436-55 (1996).

9. See Zygmunt Plater, *Environmental Law as a Mirror of the Future: Civic Values Confronting Market Force Dynamics in a Time of Counter-revolution*, 23 B.C. ENVTL. AFF. L. REV. 733, 735 (1996) (cataloguing reforms proposed in the first 100 days of the 104th Congress).

environmental regulation rests on an assumption that the only goal of such regulation is to prevent premature human death.

This reductionism is evidenced in part by silence. One of the most famous and influential critiques of current regulation, Justice Breyer's book, *Breaking the Vicious Circle*,¹⁰ contains scarcely a single reference to a living thing other than a human.¹¹ The message is that such things are irrelevant.

This reductionism is perhaps best exemplified, however, by the positive evidence gathered in support of current critiques. Particularly striking is the ubiquitous use of a table of figures, compiled by an economist at the Office of Management and Budget named John Morrall, comparing the *cost per human life saved* of various federal regulations. According to Morrall's figures, this cost varies dramatically from regulation to regulation, from a low of \$100,000 per life saved, to a high of \$72 billion. One-third of the regulations on Morrall's list reportedly cost over \$100 million for every life they save.¹²

Morrall's table has been offered in support of each of the critiques of current regulation that I have mentioned. It has been relied on to argue that the costs of many environmental regulations exceed their benefits;¹³ that many regulations are cost-ineffective, or that there are cheaper ways of saving human lives;¹⁴ that expensive regulations endanger human lives by their very expensiveness;¹⁵ and that government does not set priorities in a rational manner.¹⁶ Indeed, it is rather rare to find an article

10. See *supra* note 7.

11. See Lisa Heinzerling, *Political Science*, 62 U. CHI. L. REV. 449, 463 (1995) (discussing BREYER, *supra* note 7).

12. See John F. Morrall III, *A Review of the Record*, REG. 25, 30 tbl.4 (Nov./Dec. 1986). For a critique of Morrall's figures, see Lisa Heinzerling, *Regulatory Costs of Mythic Proportions*, 107 YALE L.J. (Forthcoming 1998) (finding that agencies' implicit estimates of the costs per life saved of the rules on Morrall's list are as much as 1000 times lower than the costs reported by Morrall, and that Morrall's high costs are largely due to his decisions to discount future lives saved and to decrease the agencies' estimates of risk).

13. See Viscusi, *Regulating the Regulators*, *supra* note 8, at 1430-36.

14. See BREYER, *supra* note 7, at 22.

15. See Viscusi, *Regulating the Regulators*, *supra* note 8, at 1451-55.

16. See Cass R. Sunstein, *Legislative Foreword: Congress, Constitutional*

critiquing risk regulation that does not at least refer to Morrall's "widely circulated table,"¹⁷ if not reproduce it in full.¹⁸

Among other things, the all-purpose support provided by Morrall's table shows the close kinship among the different critiques and their corresponding reforms. Advocates of better analysis of cost-effectiveness, risk tradeoffs, and comparative risks have offered their reforms in part as an alternative to the (controversial) option of cost-benefit analysis.¹⁹ On close inspection, however, all these reforms begin to look quite a lot alike.²⁰ The common reliance on Morrall's figures is telling in this regard.

Most important for present purposes, the pervasive reliance on estimates of the costs per human life saved of federal regulations is concrete evidence of the reductionist leanings of these criti-

Moments, and the Cost-Benefit State, 48 STAN. L. REV. 247, 257-60 (1996).

17. Susan Rose-Ackerman, *Regulatory Reform: Where Are We Going?*, 31 WAKE FOREST L. REV. 581, 582 (1996).

18. Sources relying on Morrall's table include the following: BREYER, *supra* note 7, at 24-27 tbl.5; W. KIP VISCUSI, FATAL TRADEOFFS: PUBLIC AND PRIVATE RESPONSIBILITIES FOR RISK 264 tbl.14-5 (1992); Randall Lutter & John F. Morrall III, *Health-Health Analysis: A New Way to Evaluate Health and Safety Regulation*, in THE MORTALITY COSTS OF REGULATORY EXPENDITURES 59 (W. Kip Viscusi ed., 1994); Cass R. Sunstein, *Changing Images of the State: Well-Being and the State*, 107 HARV. L. REV. 1303, 1318 tbl.8 (1994); Cass R. Sunstein, *Constitutionalism After the New Deal*, 101 HARV. L. REV. 421, 451 n.133 (1987); W. Kip Viscusi, *Equivalent Frames of Reference for Judging Risk Regulation Policies*, 3 N.Y.U. ENVTL. L.J. 431, 450-52 tbl.2 (1994); W. Kip Viscusi, *Toward a Diminished Role for Tort Liability: Social Insurance, Government Regulation, and Contemporary Risks to Health and Safety*, 6 YALE J. ON REG. 65, 88-89 (1989).

19. See, e.g., Stephen F. Williams, *The Era of "Risk-Risk" and the Problem of Keeping the APA Up to Date*, 63 U. CHI. L. REV. 1375, 1378 (1996) ("Whatever the explanation for the hostility to cost-benefit analysis, . . . it seems irrefutable that general utilitarian tradeoffs encounter greater resistance than does the balancing of pure health-health risks.").

20. For an argument that each of these basic reforms "may be deduced from a general more good than harm principle," and indeed from "'well-recognized' principles of rational decision making," see Edward W. Warren & Gary E. Marchant, *"More Good Than Harm": A First Principle for Environmental Agencies and Reviewing Courts*, 20 ECOLOGY L.Q. 379, 418 (1993) (quoting NATIONAL ACADEMY OF SCIENCES, COMMITTEE ON ENVIRONMENTAL DECISION MAKING, 2 DECISION MAKING IN THE ENVIRONMENTAL PROTECTION AGENCY 25-26 (1977)).

ques. These estimates expressly exclude any consideration other than saving human lives in judging the wisdom of regulation. It thus should come as no surprise that a major conclusion of Morrall's original paper describing the costs per life saved of various regulations was that safety regulations were more cost-effective than health regulations.²¹ Safety regulations, by definition, protect only human lives. Regulation of cars' steering columns, unvented space heaters, airplanes' fire safety devices, and children's sleepwear, to name a few examples from Morrall's table, help only humans.²² Their full benefits are thus captured by an assessment of their costs per human life saved. The same cannot be said of health regulations pertaining to, for example, the production and use of chemicals and the disposal of hazardous wastes.²³ An estimate of the costs per human life saved of the latter regulations will not capture the full benefits of these rules: benefits which will range beyond human health to include ecological consequences. Thus reductionist critiques tend to understate the benefits and cost-effectiveness of the current regulatory system, and to overstate its perverse results and lack of a rational agenda.

Other scholars have noted a different kind of reductionism in this fixation on the number of people whom regulation saves from premature death. Human beings, they have stressed, care about more than the timing of their own deaths. They also care about how death comes about, including whether it is the result of voluntary or involuntary processes, whether the risk of death is equitably or inequitably distributed, and whether the mechanism of death poses a risk to future generations.²⁴ These non-

21. See Morrall, *supra* note 12, at 32-33.

22. Such regulations appear at the top of Morrall's chart, which lists regulations in declining order of cost-effectiveness. *Id.* at 30 tbl.4.

23. Such regulations appear at the bottom of Morrall's chart. *Id.*

24. For a classic discussion of the research showing a divergence in lay and expert perceptions of risk, which has spawned a huge body of writing in law, political science, and cognitive psychology, see Paul Slovic, *Perception of Risk*, 236 *SCI.* 280 (1987). For important accounts of the legal implications of this divergence, see Clayton P. Gillette & James E. Krier, *Risk, Courts, and Agencies*, 138 *U. PA. L. REV.* 1027 (1990); Donald T. Hornstein, *Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis*, 92 *COLUM. L. REV.* 562 (1992).

statistical features of risk, now familiar to any student of risk and its regulation, figure importantly in the public's perceptions of risk. Yet they are ignored if the sole measure of regulatory success is the prevention of premature death. There appears to be a developing consensus that these features of risk are relevant to regulatory decisionmaking.²⁵ Thus, I do not mean to suggest that reductionism in all its forms has gone unnoticed and unaddressed in the debate on regulatory performance. But even the attention to the nonstatistical features of risk takes human beings to be its sole concern.

II. REDUCTIONIST REFORMS

Given the reductionist leanings of current critiques of the regulatory system, it is not surprising that the proposals for reform that have grown out of these critiques exhibit the same reductionist impulses. I address each of the major proposals in turn.

A. Cost-Benefit Analysis

From the beginning, the major environmental statutes in this country have been criticized for paying insufficient attention to costs.²⁶ Several of our most important environmental laws have, in fact, been interpreted to *forbid* the consideration of costs in the establishment of environmental standards.²⁷ In order to en-

25. See John D. Graham, *The Risk Not Reduced*, 3 N.Y.U. ENVTL. L.J. 382, 393 (1994). For a sustained defense of the consideration of non-statistical features of risk in risk regulation, see Richard H. Pildes & Cass R. Sunstein, *Reinventing the Regulatory State*, 62 U. CHI. L. REV. 1, 36-64 (1995).

26. For an early criticism of the Clean Air Act on this score, see James Krier, *The Irrational National Air Quality Standards: Macro- and Micro-Mistakes*, 22 UCLA L. REV. 323 (1974).

27. See, e.g., *Tenn. Valley Auth. v. Hill*, 437 U.S. 153 (1978) (once a federal action is found to jeopardize an endangered species in violation of the Endangered Species Act, courts may not balance costs and benefits in deciding whether to enjoin the federal action); *Natural Resources Defense Council, Inc. v. EPA*, 824 F.2d 1146 (D.C. Cir. 1987) (EPA may not consider costs in determining level of acceptable risk for hazardous air pollutants under Clean Air Act); *Lead Industries Ass'n, Inc. v. EPA*, 647 F.2d 1130 (D.C. Cir. 1980) (EPA may not consider costs

sure a favorable balance between costs and benefits, recent proposals for regulatory reform have advocated increased reliance on cost-benefit analysis.²⁸ For example, one provision of the legislative package accompanying the *Contract With America* would have required that all major federal regulations pass a cost-benefit test.²⁹

In theory, cost-benefit analysis does not require that the goals of environmental law be reduced to one dimension: that of protecting human health. In practice, however, manageable cost-benefit analysis will almost certainly involve this kind of reductionism, for the basic reason that the methods used to quantify damages to natural resources are at present so immature. This immaturity is true both of methods used to estimate risk to natural resources, and of methods used to value the estimated risk.

The Environmental Protection Agency (EPA) has only recently issued guidelines for ecological risk assessment,³⁰ and some of the most basic methodological questions remain unresolved.³¹ Of particular importance is the fact that current methods for ecological risk assessment operate site-specifically; for example, they help determine the risk of ecological harm caused by the application of pesticide on a particular field.³² They have not, thus

in setting National Ambient Air Quality Standards under Clean Air Act); *Hercules, Inc. v. EPA*, 598 F.2d 91 (D.C. Cir. 1978) (EPA may not consider costs in setting effluent limits for toxic water pollutants under Clean Water Act).

28. Despite the prohibition on the consideration of costs in many environmental statutes, many studies, using conventional cost-benefit analysis, have concluded that the overall benefits of environmental requirements overwhelm their overall costs. *See, e.g.*, Environmental Protection Agency, *The Benefits and Costs of the Clean Air Act, 1970 to 1990*, Draft Report to Congress ES-11 (Apr. 1997); *Costs and Benefits of Federal Regulations*, 62 Fed. Reg. 39,352 (1997) (Office of Management and Budget) (notice and request for comments).

29. *See* Job Creation and Wage Enhancement Act, H.R. 9, 104th Cong., 1st Sess. § 3201 (1995); Risk Assessment and Cost Benefit Act of 1995, H.R. 1022, 104th Cong., 1st Sess. (1995).

30. Proposed Guidelines for Ecological Risk Assessment, 61 Fed. Reg. 47,552 (1996).

31. *See id.* (listing questions for commenters to address).

32. *See* NAT'L RES. COUNCIL, *ISSUES IN RISK ASSESSMENT* 259-61 (1993).

far, been used to determine the full ecological consequences of a nationwide rule. Indeed, a growing number of researchers insist that ecological theory is ill-equipped to range beyond site-specific case studies to predict ecological consequences on a broader scale.³³ Yet this is what ecological risk assessment would be called upon to do if cost-benefit analysis became the standard for major federal regulations.

The rather immature state of the science of ecological risk assessment is also illustrated by the Forest Service's efforts to implement a regulation requiring that the agency's plans for the national forests, which pertain to future actions such as timber harvests, protect "viable populations" of forest species.³⁴ In attempting to predict the effects of future uses on species viability, the Forest Service uses the "Delphi" method, which is essentially an opinion poll of experts.³⁵ Strikingly subjective and utterly opaque, this method involves asking panels of experts to estimate the likelihood of species viability under various alternative scenarios.³⁶

Another basic challenge faced by ecological risk assessment is the choice of the relevant endpoint. This choice is critical to the

33. See Sakotra Sarkar, *Ecological Theory and Anuran Declines*, 46 *BIOSCIENCE* 199 (Mar. 1996); see also K.R. SHRADER-FRECHETTE & E.D. MCCOY, *METHOD IN ECOLOGY: STRATEGIES FOR CONSERVATION* (1993); STUART L. PIMM, *THE BALANCE OF NATURE: ECOLOGICAL ISSUES IN THE CONSERVATION OF SPECIES AND COMMUNITIES* (1991).

34. The planning requirement is set forth in the National Forest Management Act of 1976, 16 U.S.C. § 1600-87 (1996). The viability requirement appears at 36 C.F.R. § 219.19 (1996). For a wonderful and thoughtful account of the Forest Service's implementation of the viability requirement, see Oliver A. Houck, *On the Law of Biodiversity and Ecosystem Management*, 81 *MINN. L. REV.* 869 (1997).

35. See U.S. FOREST SERV., U.S. BUREAU OF LAND MANAGEMENT, *FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT ON MANAGEMENT OF HABITAT FOR LATE-SUCCESSIONAL AND OLD-GROWTH FOREST RELATED SPECIES WITHIN THE RANGE OF THE NORTHERN SPOTTED OWL* 116-17 (1994).

36. For a description of the Delphi method, see DOUGLAS N. SWANSTON ET AL., U.S. DEP'T OF AGRICULTURE, FOREST SERV., *PACIFIC NORTHWEST RESEARCH STATION GENERAL TECHNICAL REPORT, SCIENTIFIC INFORMATION AND THE TONGASS LAND MANAGEMENT PLAN: KEY FINDINGS FROM THE SCIENTIFIC LITERATURE, SPECIES ASSESSMENTS, RESOURCE ANALYSES, WORKSHOPS AND RISK ASSESSMENT PANELS* 386 (Nov. 1996).

outcome of the risk assessment, as it will "directly influence the type, characteristics, and interpretation of data and information, . . . and the scale and character of the assessment."³⁷ EPA's proposed guidelines for ecological risk assessment define assessment endpoints as the "explicit expressions of the actual environmental value that is to be protected," and provide that endpoints must "include both a valued ecological entity and an attribute of that entity that is important to protect and potentially at risk (e.g., nesting and feeding success of piping plovers or areal extent and patch size of eel grass)."³⁸

In human risk assessments, for better or worse, researchers have predominantly focused on the endpoint of cancer.³⁹ There is no such readily identifiable endpoint of concern when it comes to ecological risk.⁴⁰ EPA's guidelines provide that endpoints should neither be too broad nor too narrow,⁴¹ and should reflect "values and organisms that people care about" but not be "based on public perceptions alone."⁴² Given the vagueness of these prescriptions, it is no wonder EPA cautions that "ecological risk assessment is a rapidly evolving discipline," and that EPA intends to develop more detailed guidance on specific topics at a later date.⁴³

Compared to current methods used to estimate ecological risks, the methods used to estimate human health risks seem exceedingly stable and transparent. EPA has long operated under guidelines for assessing human cancer risks.⁴⁴ The fundamental challenge has been to develop protocols for dealing with gaps in data, protocols that have come to be known as "default assumptions." These include, for example, the assumptions that the

37. Proposed Guidelines for Ecological Risk Assessment, *supra* note 30, at 47,568.

38. *Id.* at 47,555.

39. See, e.g., David A. Wirth & Ellen K. Silbergeld, *Risky Reform*, 95 COLUM. L. REV. 1857, 1864-65 (1995) (book review).

40. See NAT'L RES. COUNCIL, *supra* note 32, at 253.

41. See Proposed Guidelines for Ecological Risk Assessment, *supra* note 30, at 47,568.

42. *Id.*

43. *Id.* at 47,560.

44. See Guidelines for Carcinogen Risk Assessment, 51 Fed. Reg. 33,992 (1986).

presence or absence of effects observed in one human population are predictive of effects in another exposed human population; that the presence or absence of effects observed in an *animal* population are predictive of effects in an exposed human population; and that a linear dose-response curve accurately describes the relationship between observed effects at high exposures and probable effects at low exposures.⁴⁵ Default assumptions like these have been the subject of intense scrutiny and rethinking,⁴⁶ and yet they have survived essentially intact. Moreover, courts have regularly upheld agency estimates of human cancer risk based on quantitative risk assessments using these assumptions.⁴⁷ There is, in other words, considerable agreement about how to conduct cancer risk assessment in the face of incomplete information. Nevertheless, quantitative risk assessment remains extremely controversial.⁴⁸ Imagine, then, the controversy that would attend risk assessments conducted according to the vague, opaque, and fluid prescriptions for ecological risk assessment. Yet such assessments would be the necessary foundation for any cost-benefit analysis of regulations designed to protect natural resources.

45. For a clear description of the major default assumptions EPA uses in conducting cancer risk assessments, see Proposed Guidelines for Ecological Risk Assessment, *supra* note 30.

46. See, e.g., NATIONAL RESEARCH COUNCIL, RISK ASSESSMENT IN THE FEDERAL GOVERNMENT: MANAGING THE PROCESS (1983). See also NATIONAL RESEARCH COUNCIL, UNDERSTANDING RISK: INFORMING DECISIONS IN A DEMOCRATIC SOCIETY (Paul C. Stern & Harvey U. Fineberg eds., 1996). In response to criticisms of existing methods for assessing human cancer risk, EPA has proposed new guidelines for this purpose. See Proposed Guidelines for Ecological Risk Assessment, *supra* note 30.

47. See, e.g., Pub. Citizen Health Research Group v. Tyson, 796 F.2d 1479 (D.C. Cir. 1986) (upholding Occupational Safety and Health Administration's rule limiting workplace exposure to ethylene oxide, based on animal studies and no-threshold, linear dose-response model); Synthetic Organic Chemical Manufacturers Ass'n v. Dep't of Health & Human Services, 720 F. Supp. 1244 (W.D. La. 1989) (upholding Health & Human Service's classification of certain chemicals as known or suspected carcinogens based on results in animal studies).

48. For a concise discussion of the major criticisms, see BREYER, *supra* note 7, at 42-50.

Methods for *valuing* the benefits of natural resources that are not directly traded in markets are equally undeveloped. Several methods exist for measuring the valuation implied by private market behavior relating to natural resources, such as the purchase of property with unusual environmental amenities or the expenditure of money to travel to a place with such attractions.⁴⁹ However, valuations based on the actual use of a natural resource do not capture values which are not tied to use of those resources, so-called "non-use" values. Generally speaking, non-use values protect opportunities — to see an elephant in its natural setting, to have one's children see it, even to know that it exists at all. These benefits can be an important part of the value we attach to natural resources, and indeed in some sense they embody the quintessential reasons for protecting natural resources in the first place.

Currently, the only method for valuing the non-use benefits of natural resources is contingent valuation.⁵⁰ Contingent valuation is "damage assessment by public opinion poll";⁵¹ it uses surveys to elicit the value each individual attaches to the preservation or destruction of unpriced goods such as natural resources. Contingent valuation is, however, besieged by critics. Critics charge that the hypothetical nature of contingent valuation surveys leads to inflated valuations (put simply, survey respondents are not required to put their money where their mouth is);⁵² that survey respondents frequently fail to distinguish between a subset of a natural resource (such as a flock of snow geese) and the entire resource (all snow geese);⁵³ that responses differ markedly de-

49. See, e.g., Kenneth E. McConnell, *Indirect Methods for Assessing Natural Resource Damages Under CERCLA*, in VALUING NATURAL ASSETS: THE ECONOMICS OF NATURAL RESOURCE DAMAGE ASSESSMENT 153-203 (1993); NAT'L RES. COUNCIL, *supra* note 32, at 263-64.

50. See generally R.G. CUMMINGS ET AL., VALUING ENVIRONMENTAL GOODS: AN ASSESSMENT OF THE CONTINGENT VALUATION METHOD (1986).

51. Katherine K. Baker, *Consorting with Forests: Rethinking Our Relationship to Natural Resources and How We Should Value Their Loss*, 22 *ECOLOG. L.Q.* 677, 680 (1995).

52. See PETER S. MENELL & RICHARD B. STEWART, ENVIRONMENTAL LAW AND POLICY 1195-96 (1994).

53. See, e.g., Daniel Kahneman & Jack L. Knetsch, *Valuing Public Goods: The Purchase of Moral Satisfaction*, 22 *J. ENVTL. ECON. & MGMT.* 57

pending on whether a natural resource is being valued on its own (such as one timber stand) or as part of a larger set of natural resources (such as all the forests in a multi-state region);⁵⁴ and that survey responses are acutely and unduly sensitive to the way the questions are framed. On the last point, an issue of considerable importance is whether to frame questions in the "willingness-to-pay" format (how much would you be willing to pay to avoid an oil spill equivalent to the Exxon-Valdez spill?) or "willingness-to-accept" format (how much would you accept in return for allowing such a spill to occur?). Survey responses depend dramatically on which type of question is asked; researchers have found that the willingness-to-accept format leads to valuations three to nineteen times greater than the willingness-to-pay format.⁵⁵ Federal agencies conducting natural resource damage valuations have opted for the willingness-to-pay format in order to avoid "disproportionately high" valuations.⁵⁶ But of course this begs the question of valuation which the surveys are intended to address.

The literature on contingent valuation is vast, and I have sketched only the broadest outlines of the debate here. I hope I have said enough to show, however, that any attempt to value the benefits of regulation protecting natural resources will encounter severe methodological difficulties. In this regard, it is telling that although federal agencies have begun to embrace contingent valuation as a means of measuring the value of contaminated natural resources,⁵⁷ the few courts that have passed on the application of this method to actual cases have been hostile to it.⁵⁸

(1992).

54. This is known as the problem of "embedding." See Baker, *supra* note 51, at 715.

55. See Daniel S. Levy & David Friedman, *The Revenge of the Redwoods? Reconsidering Property Rights and the Economic Allocation of Natural Resources*, 61 U. CHI. L. REV. 493, 506-07 (1994).

56. *State of Ohio v. U.S. Dep't of the Interior*, 880 F.2d 432, 476 n.82 (D.C. Cir. 1989).

57. See Baker, *supra* note 51, at 681-82.

58. See MENELL & STEWART, *supra* note 52, at 1197 (noting that in the one case using contingent valuation surveys to measure non-use values that has been brought to trial, the court disallowed evidence of

In sum, methods for estimating and valuing risks to natural resources are at present too undeveloped to permit reasonably thorough and reliable quantification of the benefits of regulation protecting natural resources. And benefits that are unquantified are famously disadvantaged — either ignored altogether or “dwarfed” by quantified costs — in cost-benefit analysis.⁵⁹

B. Cost-Effectiveness Analysis

Due to the difficulty of estimating the true value of the benefits of environmental regulation, some regulatory reformers have turned away from arguments based on cost-benefit analysis and have turned their attention instead to cost-effectiveness analysis.⁶⁰ One provision of the legislation accompanying the *Contract With America* would have required agencies to adopt the most cost-effective means of carrying out their regulatory responsibilities.⁶¹ President Clinton’s executive order on regulatory review contains a similar requirement.⁶² The general idea is that even if the current regulatory system produces more benefits than costs, it still costs more than it has to, and the same benefits we now enjoy

non-use value based on this method). See also *Mercado v. Ahmed*, 756 F. Supp. 1097 (N.D. Ill. 1991), *aff’d*, 974 F.2d 863 (7th Cir. 1992) (excluding testimony relying on contingent valuation studies which purported to measure value of lost pleasure of life).

59. See, e.g., Laurence H. Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process*, 84 HARV. L. REV. 1329, 1361-65, 1389-91 (1971); Laurence H. Tribe, *Ways Not to Think About Plastic Trees: New Foundations for Environmental Law*, 83 YALE L.J. 1315, 1317-20 (1974).

60. See Paul R. Portney & Robert N. Stavins, *Regulatory Review of Environmental Policy: The Potential Role of Health-Health Analysis*, in THE MORTALITY COSTS OF REGULATORY EXPENDITURES 112, 113 (W. Kip Viscusi ed., 1994).

61. Comprehensive Regulatory Reform Act of 1995, S. 343, 104th Cong., 1st Sess. (1995).

62. Exec. Order No. 12,866, 58 Fed. Reg. 51,735 (1993) (Regulatory Planning and Review § 1(b)(11)) (“Each agency shall tailor its regulations to impose the least burden on society, including individuals, businesses of differing sizes, and other entities (including small communities and governmental entities), consistent with obtaining the regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations.”).

could be obtained at a fraction of the cost. Unfortunately, evaluations of the cost-effectiveness of regulations have also begun to focus on human lives saved as the signal measure of regulatory success.

Two specific proposals have been offered to make the regulatory system more cost-effective. First, many scholars have argued that the current system of environmental protection costs more than it has to because it relies primarily on technology-based regulation. They have proposed using market-based regulation, such as pollution taxes and emissions trading programs, to achieve the same degree of environmental protection as a technology-based regime, but at far lower cost.⁶³ Second, many have argued that a comparison of the costs per life saved of various federal regulations shows rich opportunities to save human lives at a relatively low cost, and also shows that these opportunities have been squandered by extravagant attention to tiny risks.⁶⁴ In particular, as noted above, the argument has been made that focusing more attention on safety as opposed to health risks — for example, requiring the installation of smoke detectors in airplanes rather than regulating arsenic in the ambient air — would improve the cost-effectiveness of federal regulation.⁶⁵

As for the first set of claims, ensuring that market-based regulation achieves the same degree of environmental protection as technology-based regulation is complicated. It requires both a prediction, in the face of profound scientific uncertainty, of human health effects and ecological consequences, and also a means of comparing one type of impact with another. The temptation is to minimize the effect of scientific uncertainty by considering only the impacts current science allows us to measure, and to mitigate the difficulty of comparing different kinds of

63. For the classic statements of this argument in the legal literature, see Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333 (1985); Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 COLUM. J. ENVTL. L. 171 (1988). For a general discussion, see Lisa Heinzerling, *Selling Pollution, Forcing Democracy*, 14 STAN. ENVTL. L.J. 300, 305-10 (1995).

64. See, e.g., Morrall, *supra* note 12; sources cited, *supra* note 18.

65. See Morrall, *supra* note 12, at 32-33.

measurable impacts to each other by considering only one kind of impact.

That is indeed what appears to be happening with the current experiments in market-based regulation that are known as "environmental contracting" or "alternative compliance." These approaches, illustrated most famously by the Clinton administration's "Project XL",⁶⁶ allow firms to develop their own strategies for complying with environmental regulation, provided that they achieve the same degree of environmental protection as standard regulatory requirements would achieve.

Comparing the environmental consequences of conventional and experimental regulation would be simple if experiments such as Project XL did not allow flexibility across pollutants and across environmental media. Put another way, if Project XL merely allowed a firm to emit more sulfur dioxide from one smokestack in return for emitting less sulfur dioxide from an adjacent smokestack, comparing the environmental consequences of conventional standards and Project XL would require only a simple comparison of sulfur dioxide emissions. Yet a regulatory innovation limited in this way would quickly reach the limits of its advantage over current programs, and indeed, in some contexts, might merely duplicate the flexibility already provided by current law.⁶⁷ For this reason, Project XL has allowed firms far more flexibility than this. They may, for example, trade off increased sulfur dioxide emissions for decreased emissions of volatile organic compounds, or, more generally, increased water pollution for decreased air pollution.⁶⁸ But these cross-pollutant and cross-media tradeoffs make it hard to figure out whether the new

66. Regulatory Reinvention (XL) Pilot Projects, 60 Fed. Reg. 27,282 (1995) (solicitation of proposals and request for comment).

67. See *Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837 (1984) (upholding EPA's "bubble" policy, allowing firms flexibility in complying with certain provisions of the Clean Air Act).

68. For a description and thoughtful analysis of several Project XL proposals, see Rena I. Steinzor, *Regulatory Reinvention and Project XL: Does the Emperor Have Any Clothes?*, 26 ENVTL. L. REP. 10,527 (1996). For a critical analysis of the entire Project XL enterprise, see Rena I. Steinzor, *Reinventing Environmental Regulation: The Dangerous Journey from Command to Self-Control*, 22 HARV. ENVTL. L. REV. 103 (1998).

regime provides the same degree of environmental protection as the old.

At first, somewhat astonishingly, EPA officials explicitly refused to establish an environmental baseline against which new compliance strategies could be measured. In other words, EPA refused to decide whether compliance strategies would be evaluated according to total emissions, ambient concentrations, human impacts, ecosystem impacts, or some other measure of environmental harm.⁶⁹ Increasingly, however, this indecision is proving untenable, as the newly flexible programs threaten to become a kind of "regulatory free-for-all" in which it is impossible to say whether firms' suggested compliance strategies are, from an environmental perspective, better than, worse than, or equivalent to standard strategies.⁷⁰ To mitigate this difficulty, EPA is considering whether to allow quantitative risk assessment as a means of assessing the environmental impacts of proposed programs under Project XL.⁷¹ In practice, this would mean that the yardstick for determining whether proposed compliance strategies provide the same degree of environmental protection as conventional requirements would be human health risk and, more narrowly still, human cancer risk.⁷² As a result, in choosing compli-

69. See Steinzor, *Regulatory Reinvention and Project XL*, *supra* note 68, at 10,529 (quoting Memorandum from David Gardiner, Assistant Administrator, U.S. EPA, OPPE, on Draft Principles for Development of Project XL Final Project Agreements 10-11 (Dec. 1, 1995)) ("A consideration of environmental performance first requires consideration of the unit of measure. This was not specifically defined in the Project XL Federal Register notice in order to encourage creativity on the part of project sponsors. Projects may seek to define environmental baselines in any number of ways, such as general environmental indicators, pollutant emissions, ambient concentrations, or human or ecosystem impacts . . .").

70. Steinzor, *Regulatory Reinvention and Project XL*, *supra* note 68, at 10,529; see also Steinzor, *Reinventing Environmental Regulation*, *supra* note 68, at 137-38.

71. See Steinzor, *Regulatory Reinvention and Project XL*, *supra* note 68, at 10,531.

72. See, e.g., Wirth & Silbergeld, *supra* note 39, at 1865; see also NATIONAL RESEARCH COUNCIL, SCIENCE AND JUDGMENT IN RISK ASSESSMENT 41 (1994) (noting claim that current methodologies for quantitative risk assessment are primarily aimed at assessing human cancer risk).

ance strategies under these new programs, ecological consequences may be left out of the picture entirely except insofar as they fortuitously coincide with human cancer risks.

Reforms based on comparison of the costs per human life saved of various regulatory interventions follow a similarly reductionist path. As discussed above, comparing costs per life saved explicitly excludes any consideration other than saving human lives when judging regulations, thus understating the benefits of health regulation designed to protect both human health and the environment.

Even if one's only concern were human health, current estimates of the cost per human life saved of federal regulations would still understate the benefits of many health regulations. Consider again John Morrall's famous table. The human health benefits of the regulations found at the bottom of the table — according to Morrall, the least cost-effective of the regulations he reviewed — were estimated by the agencies using quantitative risk assessments. These quantitative assessments almost invariably considered only human cancer risk.⁷³ The table's estimates of the number of lives saved by these regulations thus exclude not only ecological consequences, but also noncancer human health effects, despite the fact that in promulgating the rules the agencies often expressed a clear goal of preventing (unquantified) health

73. See *Occupational Exposure to Ethylene Dibromide*, 48 Fed. Reg. 45,956 (1983) (proposed rule) (quantitative risk assessment for ethylene dibromide ("EDB") considered only cancer risk); *National Emission Standards for Hazardous Air Pollutants; Benzene Emissions From Maleic Anhydride Plants, Ethylbenzene/Styrene Plants, and Benzene Storage Vessels*, 49 Fed. Reg. 23,558 (1984) (withdrawing proposed benzene/storage, benzene/ethylbenzenol styrene, and benzene/maleic anhydride standards on ground that risk from leukemia, the only risk quantified in proposing the standards, was "too small to warrant federal regulatory action"); *National Emission Standards For Hazardous Air Pollutants; Standards For Inorganic Arsenic*, 51 Fed. Reg. 27,956 (1986) (final rule) (standards for arsenic/glass manufacturing and arsenic/low-arsenic copper based on cancer risks); *National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides*, 49 Fed. Reg. 43,906 (1984) (withdrawing proposed standards for radionuclides at DOE facilities and at elemental phosphorous plants; proposed standards based on estimates of cancer risk alone).

effects other than cancer.⁷⁴ The absurdity of relying on the results of cancer-driven quantitative risk assessments to fully account for the benefits of these rules is brought home by imagining that the same test were applied to the rules at the top of the list, the safety rules Morrall defends. According to Morrall, one of the most cost-effective federal regulations is the rule pertaining to unvented space heaters, which reportedly saves lives at a cost of \$100,000 apiece.⁷⁵ Unvented space heaters pose a risk of death from carbon monoxide poisoning.⁷⁶ Suppose that this regulation were judged according to a quantitative risk assessment which estimated how many cancer deaths would be prevented by the rule. The answer would be zero, as the regulation is not designed to prevent human cancer.

In short, if cost-effectiveness is to be the measure of the wisdom and validity of environmental regulations, the identification of the goals of regulation — the achievement of which determines cost-effectiveness — becomes critical. And in this context, too, regulatory reforms appear to assume that the only goal of environmental regulation is to protect human health.

C. Risk Tradeoffs

The identification of risk tradeoffs, or ways in which regulation designed to decrease risk may in fact increase risk, has become a pervasive feature of the literature on risk regulation. A recent

74. See, e.g., Asbestos; Manufacture, Importation, Processing, and Distribution in Commerce Prohibitions, 54 Fed. Reg. 29,460, 29,468 (1989) (final rule); National Emission Standards for Hazardous Air Pollutants, Benzene Emissions from Ethylbenzene/Styrene Plants, 45 Fed. Reg. 83,448-49 (1980) (proposed rule); Occupational Exposure to Ethylene Dibromide, 48 Fed. Reg. 45,956 (1983) (Occupational Safety and Health Administration) (notice of proposed rulemaking); Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite, 51 Fed. Reg. 22,612, 22,666 (1986) (Occupational Safety and Health Administration) (final rules); Occupational Exposure to Ethylene Oxide, 49 Fed. Reg. 25,734, 25,765-66 (1984) (final standard); Hazardous Waste Management, 51 Fed. Reg. 44,714-15 (1986) (proposed rule).

75. See Morrall, *supra* note 12, at 30 tbl. 4.

76. See Safety Standard Requiring Oxygen Depletion Safety Shutoff Systems (ODS) for Unvented Gas-Fired Space Heaters, 45 Fed. Reg. 61,880 (1980) (Consumer Product Safety Commission).

book on the subject consists largely of a series of case studies describing the countervailing risks created by various regulatory requirements.⁷⁷ Other writings on risk regulation similarly spend a good deal of time exposing the unintended consequences of regulations intended to reduce risk.⁷⁸

Two basic kinds of risk tradeoffs have been described so far. First, the *cost* of regulations designed to reduce risks may itself increase risk through effects on personal income. "Richer is safer," in other words: income affects health, and so decreases in income brought about by regulation may impair health as well as wealth.⁷⁹ Second, regulations may create "risk offsets" or "substitution risks."⁸⁰ To cite a tragic example that has lately been much in the news, air bags designed to protect adults from the impact of a crash may kill more children than they save.⁸¹

The existence — some would say ubiquity⁸² — of risk tradeoffs, and the perception that agencies have been insufficiently attentive to such tradeoffs, have led to calls for an explicit requirement that agencies take account of risk tradeoffs in making regulatory decisions. One provision of the legislation accompanying the *Contract With America* would have required agencies to consider "substitution risks" created by regulations.⁸³ Legal academics have similarly recommended requiring analysis of risk tradeoffs.⁸⁴ Because it "measures benefits in . . . physical rather than

77. RISK VERSUS RISK: TRADEOFFS IN PROTECTING HEALTH AND THE ENVIRONMENT (John D. Graham & Jonathan Baert Wiener eds., 1995).

78. See, e.g., Cass R. Sunstein, *Paradoxes of the Regulatory State*, 57 U. CHI. L. REV. 407 (1990).

79. For a preliminary but classic statement of this argument, see Aaron Wildavsky, *Richer is Safer*, 60 PUB. INTEREST 23, 27-29 (1980).

80. Viscusi, *Regulating the Regulators*, *supra* note 8, at 1449.

81. For a poignant discussion, see Robert C. Sanders, *Air Bags Can Kill Kids*, WASH. POST, Oct. 23, 1996, at A23.

82. See John P. Graham & Jonathan Baert Wiener, *Confronting Risk Tradeoffs*, in RISK VERSUS RISK, *supra* note 77, at 12 (risk tradeoffs are "ubiquitous").

83. Risk Assessment and Cost-Benefit Act of 1995, H.R. 1022, 104th Cong. § 105(4), 1st Sess. (Feb. 23, 1995), in 141 Cong. Rec. H2261, H2263 (Feb. 27, 1995).

84. Cass R. Sunstein, *Health-Health Tradeoffs*, 63 U. CHI. L. REV. 1533, 1564-67 (1996).

monetary units," risk tradeoff analysis offers the possibility of eluding the valuation difficulties that have dogged cost-benefit analysis.⁸⁵

Unfortunately, however, much risk tradeoff analysis also tends to proceed as if the only goal of environmental law were to protect human health. This reductionism is especially glaring with respect to the first category of risk tradeoffs described above, the mortality allegedly caused by reductions in income due to regulatory costs.

Several studies have found a correlation between wealth and health. Building on these studies, researchers have attempted to identify the level at which regulatory expenditures will produce one fatality by reducing individual wealth. One frequently cited range of estimates for this level is \$3 to 7.5 million, from a study by Ralph Keeney.⁸⁶ Numerous problems have been raised with respect to such estimates, including the possibility that the wealth-health relationship may not work in the direction researchers like Keeney have assumed; that is, wealthy people might be wealthy partly because they are healthy, rather than the other way around.⁸⁷ One effort to avoid this causal issue produced an estimate of the level of regulatory expenditures that will cause one fatality that is approximately ten times the level cited by Keeney.⁸⁸ Another problem with attempts to identify a uniform level

85. Portney & Stavins, *supra* note 60, at 118; *see also* Sunstein, *Health-Health Tradeoffs*, *supra* note 84, at 1549-52.

86. For the original study, see Ralph Keeney, *Mortality Risks Induced by Economic Expenditures*, 10 RISK ANALYSIS 147 (1990); for discussions relying on this estimate, *see, e.g.*, UAW v. OSHA, 938 F.2d 1310, 1326-27 (D.C. Cir. 1991) (Williams, J., concurring); BREYER, *supra* note 7, at 23; Sunstein, *Health-Health Tradeoffs*, *supra* note 84, at 1544.

87. In his oft-cited study of the relationship between regulatory expenditures and mortality, Keeney himself simply assumed that "higher incomes will lead to lower mortality risks." *See* Keeney, *supra* note 86, at 149. *But See, e.g.*, C.P. Wen et al., *Anatomy of the Healthy Worker Effect: A Critical Review*, 25 J. OCCUPATIONAL MED. 283 (1983) (discussing studies suggesting that "healthy worker effect" is a result of selection for employability, meaning that healthy people are the ones who get jobs).

88. *See* Viscusi, *Regulating the Regulators*, *supra* note 8, at 1454 (estimating level of regulatory expenditures necessary to induce one fatality

at which regulatory costs will induce one fatality is that they ignore the fact that regulatory costs will be distributed differently in different contexts. Because the relationship between health and wealth is "highly nonlinear"⁸⁹ (Donald Trump is unlikely to be less healthy than Bill Gates just because he has less money than Bill Gates), the actual distribution of regulatory costs in an individual case will make a large difference in determining whether the costs in fact impair anyone's health.⁹⁰

Most important for purposes of this paper, health-health analysis, as the name suggests, considers only the impact of regulation on human health. It does not consider the ecological consequences of nonregulation. In this respect, it is noteworthy that scholars have argued, again using John Morrall's versatile figures on cost-effectiveness, that health-health analysis should be used to reject many of the regulations appearing in Morrall's table. Professor Viscusi, for example, has argued that all of the listed regulations costing more than \$50 million per life saved fail health-health analysis.⁹¹ Yet most of the "failing" regulations are not only, and perhaps not even primarily, designed to protect human health. They are also designed to protect natural resources. Thus the tradeoffs are not so clearcut even if one accepted the controversial methodology of health-health analysis.

Reductionism also tends to pervade analyses of the second type of risk tradeoff, involving substitution risks. When it comes to evaluating the tradeoffs of safety standards, it makes sense to look only at the human health consequences of the standards. It would be bizarre, for example, to criticize a failure to consider the ecological consequences of licensing the elderly driver⁹² or of

to be \$50 million).

89. Portney & Stavins, *supra* note 60, at 116.

90. *Cf.* Sunstein, *Health-Health Tradeoffs*, *supra* note 84, at 1549.

91. *See* Viscusi, *Regulating the Regulators*, *supra* note 8, at 1454-55. *See also* Sunstein, *Health-Health Tradeoffs*, *supra* note 84, at 1544-48 (noting that estimates of the level of regulatory costs inducing one fatality range from \$3 - \$12 million, and pointing to Morrall's table as evidence that "some regulations fail health-health analysis whether or not they pass cost-benefit analysis").

92. *See* Constance Williams & John D. Graham, *Licensing the Elderly Driver*, in *RISK VERSUS RISK*, *supra* note 77, at 72-86.

recommending annual mammograms for women between the ages of 40 and 50.⁹³ Obviously, such policies are concerned only with human health. But the same one-dimensional approach has been embraced even in assessing the tradeoffs implicit in regulatory decisions affecting both human health and natural resources.

This reductionism is evident in what the regulatory reformers consider to be the mistakes of the past. Two commonly cited decisions purportedly show insufficient attention to risk tradeoffs: EPA's decisions banning DDT and asbestos. Let us see, then, how the agency treated the risk tradeoffs involved in those decisions.

In banning DDT, EPA cited the pesticide's demonstrated adverse effects on wildlife and its potential adverse effects on humans.⁹⁴ The agency forthrightly acknowledged uncertainty about DDT's effects on humans, but concluded that the persistence of DDT in the environment, its accumulation in fat tissue, and its transportability made this uncertainty potentially very costly.⁹⁵ EPA also recognized that banning DDT created a substitution risk: the likely substitute for DDT, methyl parathion, was more acutely toxic to humans than DDT, and thus posed a greater risk to those working closely with the pesticide, primarily farm workers.⁹⁶ The agency hoped, however, that improved labeling and training would mitigate much of this increased risk.⁹⁷

EPA's decision to ban DDT has been criticized by those who advocate closer attention to risk tradeoffs. These critics have observed, as EPA itself did, that the substitutes for DDT, the organophosphates (including methyl parathion), are more acutely toxic than DDT.⁹⁸ In fixing attention on the acutely toxic effects

93. For discussion, see Gary Taubes, *The Breast-Screening Brawl*, 275 *Sci.* 1056 (Feb. 21, 1997).

94. *See* Consolidated DDT Hearings, 37 *Fed. Reg.* 13,369, 13,370-71 (1972) (opinion and order of the administrator).

95. *See id.* at 13,370-71.

96. *See id.* at 13,374 ("The record before me leaves no doubt that the chief substitute for most uses of DDT, methyl parathion, is a highly toxic chemical and, if misused, is dangerous to applicators.").

97. *See id.* (delaying effective date of order to give time to begin educating workers who would use methyl parathion as a substitute for DDT).

98. *See* George M. Gray & John D. Graham, *Regulating Pesticides*, in

of DDT's substitutes on farm workers, as compared to the chronic effects of DDT in the general population, however, these critics ignore the vast and devastating environmental consequences of DDT.⁹⁹

Moreover, at the time of its decision, EPA was aware of, and indeed, as I have mentioned, it explicitly acknowledged, the tradeoff between the risks of DDT and the risks of methyl parathion. To the extent that advocates of risk tradeoff analysis merely seek to make regulators aware of the tradeoffs they face, and to make them consider these tradeoffs before they act, the decision to ban DDT seems unassailable. The agency recognized the tradeoff and even established requirements designed to mitigate it. Thus any criticism of the DDT ban based on EPA's simple inattention to risk tradeoffs is misguided.

One might, however, question EPA's ban of DDT on two additional grounds related to risk tradeoffs. First, EPA did not make any attempt to *quantify* the target or countervailing risks in question. If risk tradeoff analysis requires that tradeoffs be numerically quantified rather than merely described in qualitative terms, EPA's decision to ban DDT is vulnerable. But requiring quantification inadequately appreciates EPA's dilemma; could the agency afford to wait for the information permitting quantification, while in the meantime the chemical it was studying was accumulating in people and wildlife everywhere? Quantification in the context of risk tradeoff analysis is plagued by the same scientific uncertainty that dooms quantification elsewhere. If quantification of substitution risks is required, protection of natural resources will likely suffer, for reasons already discussed.¹⁰⁰

A second way to criticize the DDT ban on risk tradeoff grounds would be simply to say that EPA got the balance of risks wrong; it should not have traded off acute and known risks to workers for chronic and unquantified effects on wildlife and the general population. But this would be to say that risk tradeoff analysis is a means of second-guessing the merits of agency deci-

RISK VERSUS RISK, *supra* note 77, at 173-74, 179, 189.

99. Catalogued most famously in RACHEL CARSON, *SILENT SPRING* (1962).

100. See *supra*, Part II.A.

sions. This would assign risk tradeoff analysis a far more central and substantive role in judging agency action than has heretofore been asserted for it.¹⁰¹ And, if risk tradeoff analysis is to be assigned this substantive role, natural resources will again be the likely losers, as the benefits of protecting them are so hard to measure.

The same observations apply to EPA's decision to ban asbestos, another favorite topic in the literature on risk tradeoffs.¹⁰² In banning asbestos, EPA acknowledged that the products that would likely be substituted for asbestos might also pose risks; some of the materials that would be used for insulation if asbestos were banned were themselves carcinogens, and non-asbestos brake linings might be less effective and thus riskier than asbestos brake linings.¹⁰³ The agency chose to ban asbestos anyway, explaining that it had "more concern about the continued use and exposure to asbestos than it has for the future replacement of asbestos in the products subject to this rule with other fibrous substitutes," and that "regulatory decisions about asbestos which poses well-recognized, serious risks should not be delayed until the risk of all replacement materials are fully quantified."¹⁰⁴ In reviewing EPA's rule, the Fifth Circuit took the agency's statements on substitute products to mean that EPA had made a "decision not to evaluate" the risks posed by substitutes, and overturned the ban on this ground, among others.¹⁰⁵

Again, however, EPA did not fail to *consider* substitute risks; it simply failed to *quantify* them. Unless the proposals for mandatory risk tradeoff analysis would require quantification of risk tradeoffs, or would allow second-guessing of agency judg-

101. An exception is Warren & Marchant, *supra* note 20, at 417-28, (explicitly calling for judicial review of the substance of agency decisions).

102. See, e.g., Sunstein, *Health-Health Tradeoffs*, *supra* note 84, at 1566.

103. See Asbestos; Manufacture, Importation, Processing, and Distribution in Commerce Prohibitions, 54 Fed. Reg. 29,460, 29,481-83, 29,494-95 (1989) (final rule).

104. *Id.* at 29,481, 29,483.

105. Corrosion Proof Fittings v. EPA, 947 F.2d 1201, 1221 (5th Cir. 1991).

ments on the merits, it is hard to see where EPA went wrong in banning asbestos.

In sum, the frequent criticisms of EPA's bans of DDT and asbestos in the literature on risk tradeoffs suggests that advocates of risk tradeoff analysis have a particular kind of analysis in mind, and that is quantitative analysis of risk tradeoffs. Thus, it is surprising that few scholars have attempted such quantitative analysis themselves. One notable exception is the discussion of the risks of eating contaminated fish in a chapter of a thoughtful recent book on risk tradeoffs, *Risk versus Risk*. In this essay, Paul Anderson and Jonathan Wiener compare the risk of getting cancer from eating fish contaminated by certain synthetic chemicals with the risk of dying from heart disease as a result of *not* eating fish.¹⁰⁶ They reach the stunning conclusion that this country's death rate from heart disease could be cut by *more than one-third* if the average American would just eat an average of one meal of fish every five days instead of one meal every ten days.¹⁰⁷ According to the authors, the cardiovascular benefits of eating any fish far outweigh the cancer risks from eating contaminated fish.¹⁰⁸

Eating Fish, however, demonstrates the potential pitfalls of quantitative risk tradeoff analysis. First of all, the essay ignores natural resources; it does not even mention the ecological consequences of chemical contamination of the nation's waters. Indeed, in one parenthetical remark, the authors question whether it makes sense to spend more money reducing this contamination when we could instead be saving human lives by encouraging fish consumption — implying that the only tradeoffs here involve human health.¹⁰⁹ To be sure, the essay explicitly concerns itself only with the implications of risk tradeoff analysis for dietary recommendations (in favor of low-fat diets including fish) and fish advisories (warning against consumption of chemically-contaminated fish), and thus is, by design, concerned only with risks to humans.¹¹⁰ But this just illustrates another danger of risk

106. Paul Anderson & Jonathan Baert Wiener, *Eating Fish, in RISK VERSUS RISK*, *supra* note 77, at 104-23.

107. *See id.* at 110.

108. *See id.* at 117.

109. *See id.* at 119.

110. *See id.* at 105-06.

tradeoff analysis: the risk tradeoffs identified in the analysis will often be entirely dependent on the way the regulatory intervention is framed.

The risk tradeoff described in *Eating Fish* seems so poignant precisely because the scope of the essay was confined to regulatory interventions involving human health. The tradeoff would have been much blurrier if ecological consequences, and laws relating to water quality, had been added to the calculus. The omission of ecological consequences from this chapter of *Risk versus Risk* is all the more striking when one considers the rest of the book, which is in substantial part a brief in favor of *more* attention to ecological consequences. In a way, then, the chapter itself unwittingly illustrates the point I have been trying to make: an insistence upon the precise quantification of the risks and benefits of regulation will tend to shunt ecological consequences to the side, despite the analysts' best intentions.

Eating Fish also demonstrates another danger of quantitative risk tradeoff analysis, and that is the temptation to make too much of existing data. For their fantastic conclusions about the disease-preventative properties of fish consumption, Anderson and Wiener rely on a Danish study finding that *eating fish decreases* one's chances of dying from heart disease.¹¹¹ Anderson and Wiener conclude that the study must also stand for the converse proposition: that *not eating fish increases* one's chances of mortality from heart disease.¹¹² But this is a fallacious use of the Danish study, which tested only the consequences of a one-way intervention (eating fish), not the consequences of two different interventions (eating fish and not eating fish).¹¹³ It is also worth noting that the ninety-five percent confidence bounds of the Danish study included a relative risk of one; that is, according to the conventional measure of scientific certainty, the study came to the unremarkable conclusion that the risks of heart disease for those who eat fish were either *less, more, or the same as* for those who do not eat fish.¹¹⁴

111. *See id.* at 108-09.

112. *See id.* at 109.

113. *See id.* at 108.

114. *Id.* at 109 tbl.6.1 (showing 95% confidence bounds of relevant study).

A subsequent study by the same scientists found that the association between fish intake and mortality from coronary heart disease became non-significant when confounding effects were taken into account.¹¹⁵ In addition, a large epidemiologic study of the effects of fish oils on coronary heart disease in American male health professionals recently found no significant association between fish intake and the risk of coronary heart disease. Specifically, the study concluded that "increasing fish intake from one to two servings per week to five to six servings per week does not substantially reduce the risk of coronary heart disease among men who are initially free of cardiovascular disease."¹¹⁶

Thus, as to the merits of quantitative risk tradeoff analysis, one might paraphrase Justice Marshall's famous warning in the *Benzene* case: "To require a quantitative showing of [countervailing risks], therefore, would either paralyze [government] into inaction or force [it] to deceive the public by acting on the basis of assumptions that must be considered too speculative to support any realistic assessment of the relevant risk."¹¹⁷

To summarize, risk tradeoff analysis is not easily confined to the rather narrow role that its proponents assert for it. If the DDT and asbestos bans were misguided with respect to risk tradeoffs, they were so only because the agency failed either to quantify the countervailing risks or failed to come out right on the merits. In either case, this suggests a large and powerful role for risk tradeoff analysis, and one likely uncongenial to the protection of natural resources.

D. *Comparative Risk Analysis*

In 1987, EPA managers ranked thirty-one environmental problems based on the managers' own views of the seriousness of

115. See D. Kromhout et al., *Alcohol, Fish, Fibre and Antioxidant Vitamins Intake Do Not Explain Population Differences in Coronary Heart Disease Mortality*, 25 INT'L J. EPIDEMIOLOGY 753 (Aug. 1996).

116. A. Ascherio et al., *Dietary Intake of Marine n-3 Fatty Acids, Fish Intake, and the Risk of Coronary Disease Among Men*, 332 NEW ENG. J. MED. 977, 977 (1995).

117. *AFL-CIO v. American Petroleum Inst.*, 448 U.S. 607, 716 (1980) (Marshall, J., dissenting).

those problems. Their report, *Unfinished Business: A Comparative Assessment of Environmental Problems*, came to the rather startling and troubling conclusion that many of the problems receiving top regulatory priority were not, in the opinion of these experts, the most important problems. At the same time, several threats deemed more serious by this group were receiving little or no regulatory attention. For example, EPA experts deemed the risk from indoor air pollution — a problem given essentially no regulatory priority at that time — to be high, while concluding that the risk from hazardous waste sites — a problem consuming a large proportion of agency and societal resources, then and now — to be medium to low.¹¹⁸

Based on these findings, EPA managers concluded that the agency should rearrange its regulatory priorities by first comparing the risks of substances and activities potentially subject to regulation, and then concentrating its regulatory resources on the highest-ranked risks.¹¹⁹ A follow-up study by EPA's Science Advisory Board also concluded that EPA's priorities should be re-ordered by giving greater attention to relative risk.¹²⁰ For its part, the Clinton administration has required a form of comparative risk analysis for major federal regulations.¹²¹

Another boost to the movement for comparative risk analysis came with the publication, in *Science* magazine, of an article by scientists Bruce Ames, Renae Magaw, and Lois Gold.¹²² In this ar-

118. See EPA, OFFICE OF POLICY ANALYSIS, UNFINISHED BUSINESS: A COMPARATIVE ASSESSMENT OF ENVIRONMENTAL PROBLEMS (1987).

119. See *id.* at ii, 95.

120. See EPA, SCIENCE ADVISORY BOARD, REDUCING RISK: SETTING PRIORITIES AND STRATEGIES FOR ENVIRONMENTAL PROTECTION 16, 19-20 (1990) [hereinafter EPA, REDUCING RISK]. For a general discussion of the Science Advisory Board's report and recommendations, see Robert F. Blomquist, *The EPA Science Advisory Board's Report on "Reducing Risk": Some Overarching Observations Regarding the Public Interest*, 22 ENVTL. L. 149 (1992).

121. See Exec. Order No. 12,866, 58 Fed. Reg. 51,735 (1993) (*Regulatory Planning and Review*, § 1(b)(4)) ("In setting regulatory priorities, each agency shall consider, to the extent reasonable, the degree and nature of the risks posed by various substances or activities within its jurisdiction.").

122. Bruce N. Ames et al., *Ranking Possible Carcinogenic Hazards*, 236

ticle, Ames and his colleagues developed a scale for comparing the carcinogenic risks to humans posed by various substances. This scale, the so-called "HERP index," expresses carcinogenic risks as the ratio of estimated human exposures ("Human Exposure dose") to the daily dose rate of the substance required to halve the percentage of tumor-free rodents, or the dose that causes cancer in half of the animals studied ("Rodent Potency dose"). Based on the HERP index, Ames and his colleagues contended that the risks we face from such seemingly benign items as mushrooms, celery, figs, and alfalfa sprouts are similar to those we face from PCBs, dioxin, benzene, and synthetic pesticides.¹²³ With this stunning conclusion, it is no surprise that this article made a splash in the popular press¹²⁴ and led to calls for increased use of comparative risk analysis in setting regulatory priorities.¹²⁵

In theory, comparative risk assessment need not fall prey to the kind of reductionism I have discussed in this paper; that is, it need not concern itself solely with risks to human health. In theory, certainly, quantitative methods for assessing ecological risk can be developed, and recently there has been some movement in this direction.¹²⁶ Indeed, in describing what EPA's priorities might look like if they were rearranged based on comparative risk assessment, the Agency's Science Advisory Board called for greater attention to ecological risk, stating that the "EPA should attach as much importance to reducing ecological risk as it does to reducing human health risk."¹²⁷ Specifically, the Board recom-

SCI. 271 (Apr. 17, 1987).

123. See *id.* at 273 tbl.1.

124. See, e.g., Jane E. Brody, *New Index Finds Some Cancer Dangers Are Overrated and Others Ignored*, N.Y. TIMES, Apr. 17, 1987, at A10; Harold Gilliam, *Mother Nature's Own Carcinogens*, S.F. CHRON., June 2, 1981, at 10/Z1.

125. See, e.g., BREYER, *supra* note 7, at 17 (equating risks of polychlorinated biphenyls (PCBs) with risk from eating a raw mushroom, and risk of the grain fumigant ethyl dibromide (EDB) with risk of swimming for an hour in a chlorinated swimming pool, and questioning current regulatory priorities on basis of such comparisons).

126. See *supra* notes 30-43 and accompanying text (discussing EPA's proposed guidelines for ecological risk assessment).

127. EPA, REDUCING RISK, *supra* note 120, at 17.

mended that more regulatory resources be devoted to habitat alteration and destruction, species extinction and loss of biodiversity, stratospheric ozone depletion, and global climate change.¹²⁸

Again, however, one must distinguish theory and practice. Comparative risk assessment has always had a close working relationship with quantitative risk assessment: “[q]uantitative risk assessment has been employed not only to evaluate risks from individual chemicals, but also to compare risks from different substances.”¹²⁹ As a result, comparisons among risks have predominantly focused on statistical probabilities of human morbidity and mortality.¹³⁰ This fixation on human sickness and death ignores the nonstatistical features of risk such as autonomy, equity, and community.¹³¹ It also tends to ignore noncancer health effects in humans.¹³² And, most pertinent to the current discussion, quantitative risk assessment centers on risks to humans.¹³³

Seen in this light, two of the major recommendations of EPA’s Science Advisory Board in its report on regulatory priorities — that resources be targeted to the greatest risks based on “the most advanced risk assessment and comparison methodologies”¹³⁴ and that ecological risk receive greater attention¹³⁵ — are in tension with each other. Admittedly, the Science Advisory Board rec-

128. *See id.* at 13.

129. Wirth & Silbergeld, *supra* note 39, at 1865.

130. *See, e.g.*, National Emission Standards for Hazardous Air Pollutants; Regulation of Radionuclides, 49 Fed. Reg. 43,906 (1984) (withdrawal of proposed standards) (comparing probabilistic cancer risks from anthropogenic radionuclide emissions to risks from background radiation); BREYER, *supra* note 7, at 5 (comparing risks from various substances and activities to risks from smoking certain number of cigarettes over a lifetime).

131. For the most comprehensive critique of comparative risk assessment on this score, see Hornstein, *supra* note 24. *See also* Rose-Ackerman, *supra* note 17, at 586.

132. *See* Wirth & Silbergeld, *supra* note 39, at 1865, 1874-75.

133. For a concise catalogue of the values ignored by comparative risk assessment, see John S. Applegate, *A Beginning and Not an End in Itself: The Role of Risk Assessment in Environmental Decision-Making*, 63 U. CIN. L. REV. 1643, 1658-66 (1995).

134. EPA, REDUCING RISK, *supra* note 120, at 16.

135. *See id.* at 18.

ognized that improved methodologies for assessing ecological risk are needed.¹³⁶ But while those methodologies are being developed, natural resource protection will suffer if regulatory priorities are based on quantitative risk assessment.¹³⁷

Even if we could measure with perfect accuracy the ecological consequences of various regulatory approaches, this would still leave the problem of comparing disparate outcomes. This is hard enough where only human health is involved; consider the difficulty of comparing the cancer risks of benzene with the cognitive risks of lead.¹³⁸ But where there is no common metric like human health, precise comparisons become even more problematic. Thus the hope that comparative risk assessment will provide a "common language"¹³⁹ for comparing risks must prove forlorn if comparative risk assessment takes account, as it should, of risks to natural resources.

III. REDUCTIONISM'S RISKS

The environmental laws that are of concern in this paper — laws regulating the pollution of air, water, and land — have the dual purpose of protecting human health and the environment. In most cases agencies writing regulations under these laws will take the protection of human beings as their first concern. Thus their quantitative analysis of risks will begin with threats to humans. My point is that, because of the difficulty of measuring and valuing risks to natural resources, their analysis is likely to end there as well. Thus natural resource protection will often end up as a kind of tag-along value, icing on the cake of a regu-

136. *See id.*

137. *Cf.* Hornstein, *supra* note 24, at 626 (noting "the tendency of comparative risk analysis to reduce complex environmental problems to simpler ones that are easier to compare" and to ignore certain environmental effects "because these effects involve consequences that cannot be even roughly estimated.").

138. *See* Wirth & Silbergeld, *supra* note 39, at 1865; *see also* Applegate, *supra* note 133, at 1660.

139. EPA, REDUCING RISK, *supra* note 120, at 2 ("The concept of environmental risk, together with its related terminology and analytical methodologies, helps people discuss disparate environmental problems with a common language.").

lation otherwise justified by the benefits of improving human health. I will illustrate this dynamic, and the problems it would create if the regulatory reforms discussed above became law, by describing two of EPA's most prominent regulatory efforts to date: the nationwide ban on asbestos and the recent decision to tighten air quality standards for ozone.

In 1989, EPA banned virtually all uses of asbestos in this country. In doing so, the agency relied on the one environmental statute we have which permits comprehensive, cross-media regulation (including bans) of pollutants, across industries and contexts. This statute, the Toxic Substances Control Act,¹⁴⁰ requires consideration of the costs and benefits of regulation, including consideration of the effects of the chemical in question on human health and the environment.¹⁴¹ EPA spent ten years and accumulated a 45,000-page record on the way to its decision banning asbestos. Ultimately, the agency concluded that the ban would save at least 202 lives that would have been lost to cancer over a thirteen-year period, and many more lives that would have been lost due to other diseases and due to cancer in later years.¹⁴² Throughout its explanation of its final rule, the agency cautioned that its numerical estimates of costs and benefits overstated costs and understated benefits.¹⁴³

In one short paragraph, EPA described the environmental effects of the asbestos ban. The agency explained that the risks to human health were the "most readily quantifiable consequences of the commercial use of asbestos" and were sufficient, standing alone, to support the rule.¹⁴⁴ However, the agency also expressed concern about the environmental effects of asbestos, on account of studies showing that asbestos caused serious health effects in animals and humans and on account of the persistence and transportability of asbestos in the environment. The agency did not attempt to quantify these effects, stating simply that "EPA be-

140. 15 U.S.C. § 2601(a)-(c) (1996).

141. *See* 15 U.S.C. § 2605(c)(1).

142. *See* Asbestos; Manufacture, Importation, Processing, and Distribution in Commerce Prohibitions, 54 Fed. Reg. 29,460, 29,468 (1989).

143. *See generally id.*

144. *Id.* at 29,480.

lieves that continued asbestos use will leave a legacy of serious health and environmental effects due to unnaturally high concentrations of asbestos in the ambient air."¹⁴⁵

Thus, in the cost-benefit analysis of the asbestos ban, benefits to wildlife and other natural resources became a kind of add-on benefit, almost a postscript to the description of the human health benefits of the rule. This arrangement of priorities is perhaps not surprising in the case of asbestos, which is one of only a handful of environmental agents "repeatedly and strongly linked to human cancer."¹⁴⁶ With the human health risks so well documented, further consideration and quantification of the ecological consequences of continued asbestos use must have appeared, to the agency at least, unnecessary; for the agency, the rule was more than adequately justified by its effects on human health. The agency's confidence proved mistaken when the Fifth Circuit overturned the asbestos ban because it adjudged the balance of costs and benefits differently from the agency. In particular, the court took the agency to task for relying on unquantified benefits in justifying its ban.¹⁴⁷

A similar arrangement of priorities, with human health the dominant concern, and natural resources deeply subordinate, appears in other contexts in which EPA has assessed the benefits of federal regulation. The most recent example comes from EPA's decision to revise the primary and secondary air quality standards for ground-level ozone.¹⁴⁸ The primary air quality standards must be set at a level adequate to protect human health, while the secondary standards protect other aspects of public welfare including natural resources.¹⁴⁹ In theory, then, EPA could use

145. *Id.*

146. Gary Taubes & Charles C. Mann, *Epidemiology Faces Its Limits*, 269 *SCI.* 164-65 (July 14, 1995).

147. *See Corrosion Proof Fittings v. EPA*, 947 F.2d 1201, 1218-19 (5th Cir. 1991).

148. *See National Ambient Air Quality Standards for Ozone: Final Rule*, 62 *Fed. Reg.* 38,856 (1997) (to be codified as 40 C.F.R. pt. 50 (1997)) [hereinafter *Final Rule*].

149. *See* 42 U.S.C. § 7409(b)(1)-(2) (1996) (primary ambient air quality standards must protect the "public health," secondary standards the "public welfare"); 42 U.S.C. § 7602(h) (1996) (defining "effects on welfare" to include "effects on soils, water, crops, vegetation, manmade

secondary air quality standards in order to provide natural resources a layer of protection above and beyond that deemed to be adequately protective of human health. EPA has, however, typically declined to issue secondary standards that are more stringent than the primary standards.¹⁵⁰ In proposing new primary and secondary standards for ozone, EPA discussed the possibility of breaking with this precedent, and establishing a secondary standard for ozone which was more stringent than the primary standard, in recognition of the fact that "plants appear to be more sensitive to ozone than humans."¹⁵¹ In its proposal, the agency offered two alternatives for the new secondary standard: a more stringent, seasonal standard, and a standard identical to the primary standard.¹⁵²

The bulk of EPA's discussion of the proposed standards for ozone relates to the primary standard, and thus details the effects of ozone on human health.¹⁵³ In proposing a new secondary standard, however, EPA also described recent studies of the effects of ozone on crops and natural resources, in controlled and natural settings. Researchers have found that ozone levels consistent with the current secondary standard lead to substantial reductions in annual crop yields.¹⁵⁴ EPA estimated that the proposed primary standard would improve crop yields so as to produce between \$490 million and \$1.42 billion in annual benefits, and that a new secondary standard would produce annual benefits ranging from \$40 million to \$580 million, depending on the specific standard chosen.¹⁵⁵

EPA also analyzed the effects of ozone on natural resources, particularly forests. The agency noted that "foliar injury is occur-

materials, animals, wildlife, weather, visibility, and climate"); *see also* National Ambient Air Quality Standards for Ozone: Proposed Rule, 61 Fed. Reg. 65,716-17 (1996) [hereinafter Proposed Rule] (explaining that primary standards protect people, secondary standards protect natural resources).

150. *See* Fischman, *supra* note 6, at 470-76.

151. Proposed Rule, *supra* note 149, at 65,735.

152. *See id.* at 65,742.

153. *See id.* at 65,723-26.

154. *See id.* at 65,736.

155. *See id.* at 65,741.

ring on native vegetation in natural parks, forests, and wilderness areas, and may be degrading the aesthetic quality of the natural landscape”¹⁵⁶ Additionally, in western forests, particularly the San Bernardino forest ecosystem, ozone has been associated with a dramatic decline in the health of ponderosa and Jeffrey pine, and with a concomitant decline in other organisms and processes including fungal microflora and lichens.¹⁵⁷ In eastern forests, the agency predicted that low-level chronic ozone “is more likely to produce subtle long-term forest responses such as shifts in species composition, rather than wide-spread community degradation.”¹⁵⁸ At the same time, the agency admitted uncertainty as to whether ozone may be implicated in eastern forests’ decreased resistance to insect damage.¹⁵⁹ As for natural resources beyond forests, EPA noted that, “[b]y affecting crops and native vegetation, [ozone] may also indirectly affect natural ecosystem components such as soils, water, animals, and wildlife, although such impacts are not quantifiable at this time.”¹⁶⁰ The agency was also unable to quantify even the impacts on the forests. In describing the benefits that would flow from a new secondary air quality standard for ozone, EPA noted that monetized benefits for categories such as Class I areas and commercial forests could not be estimated, although the proposed standards “would confer benefits . . . by reducing biomass loss, protecting functional, aesthetic, and existence values, and by preserving biodiversity and native habitat.”¹⁶¹

In its final decision on the secondary ozone standard, EPA did not retract any of these statements about the effects of ozone on crops, forests, and other natural resources.¹⁶² Nevertheless, the agency declined to set a new secondary ozone standard that was more stringent than the primary standard. The agency explained:

156. *Id.* at 65,736.

157. *See id.* at 65,737.

158. *Id.* at 65,738.

159. *See id.*

160. *Id.* at 65,735.

161. *Id.* at 65,741.

162. *See* Final Rule, *supra* note 148, at 38,874-78.

The decision not to set a seasonal secondary standard at this time is based in large part on the Administrator's recognition that the exposure, risk, and monetized valuation analyses presented in the proposal contain substantial uncertainties, resulting in only rough estimates of the increased public welfare protection likely to be afforded by each of the proposed alternative standards.¹⁶³

In short, the same pattern emerges in EPA's decision on the ozone standard as was reflected in the asbestos ban: human health effects were precisely and painstakingly quantified, and did the bulk of the work in justifying regulation, while effects on natural resources were left vague, unquantified, and looking like a regulatory afterthought.¹⁶⁴ In the case of the ozone standard, as with the asbestos ban, this vagueness about benefits to natural resources had an inhibitory effect on regulation, as it led EPA to abandon its proposal to set a secondary standard different from the primary standard.

The analytical burdens of any major rulemaking have become enormous,¹⁶⁵ and at some point the costs of further analysis outweigh its benefits.¹⁶⁶ Indeed, in many cases the cost of requiring more analysis will not simply be the cost of gathering more information; the cost will be the postponement or abandonment of the regulatory effort itself. Not all facts can be known, *now*, even if a great deal of money is spent to find them. Thus, my point is not to condemn EPA's abbreviated analysis of the environmental consequences of the asbestos ban or ozone standard. Rather, I mean to suggest that if a quantification of risks, benefits, and regulatory tradeoffs is required, and if this quantification serves as the basis for judging the validity of regulation protecting natural resources, this will likely lead to less regulation protecting natural resources, in one of two ways.

163. *Id.* at 38,877-78.

164. See also EPA, *The Benefits and Costs of the Clean Air Act, 1970 to 1990*, *supra* note 28, at 48-50 (report detailing benefits and costs of Clean Air Act does not quantify ecological benefits beyond saying they are "significant").

165. For general discussion, see Thomas O. McGarity, *Some Thoughts on "Deossifying" the Rulemaking Process*, 41 DUKE L.J. 1385 (1992).

166. See Sunstein, *Health-Health Tradeoffs*, *supra* note 84, at 1553 ("cost-benefit analysis may itself fail cost-benefit analysis, if the costs of undertaking cost-benefit analysis are high and the benefits lower").

First, where regulation simultaneously protects human health and natural resources, it may be invalidated if an insufficient proportion of the regulation's benefits is quantified. Thus, the difficulties of measuring and valuing ecological risks may end up curtailing even regulation designed to protect human health. This is one possible interpretation of the history of the asbestos ban.

Second, where regulation designed to protect human health is inadequate to protect natural resources, and where the benefits of enhanced regulation cannot be quantified due to the difficulties of measuring and valuing risks to natural resources, the enhanced regulation may fail if subject to an analytic requirement which mandates quantification. This is the fate suffered by EPA's proposed secondary standard for ozone (even in the absence of such an analytic requirement).

In either case, requiring the quantification of risks, benefits, and tradeoffs will lead to less regulation protecting natural resources, not because of the merits of the regulation, but because the analytical requirement calls for quantification that is at present beyond our means.

CONCLUSION

The greatest perceived strength of the regulatory reforms I have described is also their greatest weakness. Each of these reforms strives to make the regulatory system more rational through a particular kind of decision making process, one characterized most of all by the quantification of risks and of the benefits of reducing those risks. But reasoned quantification requires mature methods for estimating and valuing risks. We do not now possess such methods for estimating and valuing risks to natural resources, and indeed, respectful attention to the mysteries of ecology and the whims of the human soul may persuade us that such methods will forever elude us.