Loyola of Los Angeles Law Review

Volume 27
Number 3 *Symposium: Twenty-Five Years of Environmental Regulation*

Article 4

4-1-1994

Coping with Complexity

Alyson Flournoy

COPING WITH COMPLEXITY

*Alyson C. Flournoy**

There are many lessons to be drawn from the past twenty-five years of environmental regulation—lessons about interdependence in the natural, geopolitical, and economic realms; lessons about ecology and biodiversity; and lessons about international trade and economics. In part, all of these are lessons about the ever-increasing complexity that characterizes our relationship to the environment. Closely linked with this theme is our limited knowledge in this area as we try to understand and respond to the complex reality of environmental degradation. How well we cope with this complexity and uncertainty will be an important determinant of the success of our regulatory enterprise in the coming years.

Developing analytic techniques that account for the complex and uncertain facts and values involved in regulatory decisions will be a key part of any successful response to the challenges we face. This Essay suggests how analytic tools provided by the physical and social sciences can play a valuable role in responding to the difficult task we face. However, it emphasizes the limits of what these sciences can tell us. Ultimately, scientists and economists cannot tell us what questions to ask, how to balance competing values, or how much proof to demand. Lawmakers, scientists, and regulators together must assess the value of analytic techniques developed by scientists and economists, and of the information these techniques provide, in light of the policies envisioned by our laws. As we critically assess new and existing techniques, this Essay suggests that an important question to ask is whether these techniques permit decision makers and the public to make the best informed choices in light of the complex and uncertain issues involved.

This Essay begins with a brief look back at the history of the past twenty-five years of environmental regulation. I then offer illustrations from two different fields of environmental law—natural resource protection and toxics regulation—to demonstrate how analysis under current laws has proven inadequate to cope with the complexity and uncertainty we have begun to recognize. This Essay also describes two promising analytic techniques being developed—one in the area of wetlands permit-

* Associate Professor of Law, University of Florida; A.B., 1979, Princeton University; J.D., 1983, Harvard University. The Author is grateful to Donald Elliott, Lakshman Guruswamy, Carol Rose, and Gerald Torres for their thoughtful critiques of a draft of this Essay.

ting, the other in toxics regulation. These initiatives offer examples of how scientists, policy makers, and lawmakers working together can identify analytic techniques that permit the best informed choices within the regulatory context.

I. A LOOK BACK: THE EMERGENCE OF COMPLEXITY AND UNCERTAINTY

In the earliest days of the modern environmental movement, there was little question about what our problems were: the concrete and perceptible blights of the burning Cuyahoga River, of the Santa Barbara oil spill and its animal victims, and of human illness caused by air pollution. The causes of these ills seemed equally apparent to many: profitable economic activity, undertaken with insufficient attention to environmental consequences. The solutions to these problems appeared straightforward: Eliminate the harmful discharges into air and water, thereby protecting human health and the environment. The Clean Air Act Amendments of 1970,[1] the Clean Water Act of 1977,[2] and other major legislation of the early 1970s charted an ambitious course to achieve these goals.

A number of important statutes enacted during the 1970s and 1980s focused on a single medium or resource and its observable symptoms of environmental stress. Responding to apparent degradation, many statutes directed the executive branch to regulate private conduct to assure some less-than-absolute degree of protection of environmental values. These standards typically mandated agencies to balance technological feasibility and economic impacts on the one hand against concerns for health and environmental quality on the other. The standards were usually only vaguely defined by Congress, their full meaning to be articulated through the regulatory process.[3] Congress contemplated the use of tools such as cost-benefit analysis and risk assessment. But agency decision makers were afforded much discretion to interpret statutory goals and to determine how to use relevant analytic tools in achieving these goals.

1. Pub. L. No. 91-604, 84 Stat. 1676 (codified as amended in scattered sections of 42 U.S.C.).

2. 33 U.S.C.A. §§ 1251-1387 (West 1986 & Supp. 1993).

3. This model can be found across the range of pollution control and resource protection laws. *See, e.g.*, Toxic Substances Control Act, 15 U.S.C. § 2605(a) (1988 & Supp. IV 1992); Endangered Species Act of 1973, 16 U.S.C. § 1533(b) (1988); National Forest Management Act of 1976, 16 U.S.C. § 1604(g)(3) (1988); Clean Water Act of 1977, 33 U.S.C.A. § 1314(b) (West 1986 & Supp. 1993); Clean Air Act Amendments of 1970, 42 U.S.C. § 7409(b) (1988 & Supp. III 1991).

By the mid-1970s certain difficulties with this statutory model had become apparent. First, the lack of critical information on feasibility and environmental and economic issues made standard setting an arduous process. Regulatory decisions were in many cases subject to challenge because of inadequate supporting data or analysis. The result was often-lengthy battles challenging agency decisions in the courts.[4]

Second, in part due to Congress's meager direction on policies and priorities, regulators often claimed scientific authority as the basis for regulatory decisions that could not be entirely justified by scientific method. Regulators understandably sought refuge in scientific analysis and conclusions to bolster the controversial policy decisions necessitated by vague statutory directives. But this too facilitated challenges to agency decisions. It also tended to keep certain important policy choices, disguised as scientific conclusions, hidden from public view. Inadequate public understanding of policy choices and the black-and-white picture of environmental problems presented in the media contributed to a distorted public perception of environmental problems and, in some cases, a lack of public support for environmental regulation.[5] Third, it became clear that ambitious and rigorous statutory goals sometimes entailed unanticipated economic consequences. In response to these problems, statutory deadlines were pushed back, goals were modified, and agencies lumbered on with their herculean task.

Scientific knowledge evolved rapidly over this period, revealing new dimensions of natural systems and our impacts on them. We have become aware of new problems,[6] and of the interrelationship among systems and phenomena previously treated as independent.[7] An ever-

4. *See* David Schoenbrod, *Environmental Law and Growing Up*, 6 YALE J. ON REG. 357, 365-66 (1989).

5. The average citizen has consistently expressed a willingness to pay more for environmental protection. *See, e.g.*, ROPER ORG., THE ENVIRONMENT: PUBLIC ATTITUDES AND INDIVIDUAL BEHAVIOR (1990). Yet average citizens generally do not support regulatory decisions that entail personal economic sacrifice. The causes of this dissonance are complex and varied. But a process that masks the factual and normative complexity of regulatory decisions has made it much easier for the public to deny responsibility for policy choices. Thus, citizens can be simultaneously outraged at the *Exxon Valdez* incident (It was his or their fault.), at the prospect of a higher gasoline tax (Why should I have to pay?), at the garbage barge (Something should be done.), and at the prospect of higher fees for municipal garbage disposal (Why should I have to pay?).

6. These problems include groundwater pollution, hazardous waste disposal, ozone depletion, global warming, and acid rain.

7. For example, we now see the importance of the relationships among elements in an ecosystem, we recognize some previously unconsidered economic consequences of regulation, and we are grappling with the role of international trade and lending in promoting environmental degradation.

increasing body of information has potential relevance to regulatory decisions. Pollution, we have been forced to realize, is not solely a result of inattention or evil minds and cannot be entirely eliminated without radical change to our society and our economy. Our economy is based on practices that generate enormous environmental impacts, some of which we lack the resources, the know-how, or the will to eliminate. The causes of environmental degradation, direct and indirect, are more numerous than we had realized and less susceptible of complete explanation. Moreover, the natural systems affected are more complex than we earlier realized—or cared to admit. Thus, both the scientific issues and the policy choices involved in regulation are more complex than initially appeared to be the case.

Our growing knowledge base has not meant the elimination of uncertainty. As some gaps in our understanding have been eliminated, they have been replaced by other, sometimes more profound, sources of doubt. Uncertainty often characterizes our understanding of the complex systems and phenomena we have begun to recognize.[8]

As scientific knowledge has advanced and revealed new dimensions of environmental problems, our laws have only partially kept pace. In the area of pollution control, we have continued to work with a medium-specific approach, although the interdependence of natural elements has come to be viewed as central to meaningful analysis of environmental impacts.[9] In resource protection the need for an ecosystemic approach demands that we consider new laws to supplement existing mandates.[10] Our laws regarding public resource and species protection do not adequately respond to the reality of the extinction crisis: that the causes of species extinction are profoundly embedded in long-accepted but unacceptable economic practices, and that preserving species will require economic adjustment for some individuals, industries, and regions. In toxics

8. For example, uncertainties limit our understanding of how various elements of an ecosystem relate to each other, how chemical substances affect human health, and whether and how climatic change may result from ozone depletion and greenhouse gas emissions.

9. The Clean Air Act Amendments of 1970 and Clean Water Act of 1977 continue to anchor our pollution control efforts. Recent initiatives by the Environmental Protection Agency (EPA) under Administrator Browner, however, have placed new emphasis on multimedia enforcement. *See* Peter J. Fontaine, *EPA's Multimedia Enforcement Strategy: The Struggle to Close the Environmental Compliance Circle*, 18 COLUM. J. ENVTL. L. 31 (1993); *'Reconsolidation' of Authority Would Lead to Stronger EPA Enforcement, Browner Says*, [24 Current Developments] Env't Rep. (BNA) 547 (July 30, 1993).

10. Interior Secretary Bruce Babbitt's proposals to pursue an ecosystem-based approach to species protection represent a step in this direction under the current administration. *See* William K. Stevens, *Interior Secretary Is Pushing a New Way to Save Species*, N.Y. TIMES, Feb. 17, 1993, at A1.

regulation we have followed the early-adopted strategy of evaluating each candidate substance independently and focusing almost solely on cancer risk, despite growing evidence that cumulative, synergistic, and noncancer effects from these substances may be important[11] Moreover, in controlling toxics, we have relied on a data-intensive approach that predicates regulation on an often-unattainable volume of information.

Two examples follow that are drawn from this history; they highlight the shortcomings of our current regulatory approach when confronted with complexity and uncertainty. I emphasize the ways in which thoughtful attention to analytic techniques and their application may respond to these shortcomings, and offer two examples of promising regulatory initiatives.

II. Complexity and Uncertainty in Species Preservation Law

A. *Lessons from the Past*

One need not look beyond the well-known controversy over protection of the northern spotted owl and old-growth forests in the Pacific Northwest for an example of how the complexity of environmental problems and the limits of our understanding are inadequately accounted for under existing law. In enacting and amending laws relating to public land management and species preservation, Congress has recognized certain essential ecological facts. The Endangered Species Act of 1973 (ESA)[12] reflects the fact that protection of species depends upon protection of the species's habitat. The statute also reflects some understanding by Congress of the array of competing interests and values affected by listing and designation decisions.[13] Public land management mandates similarly call for a balancing of competing interests in planning for the use of public forests, with a mandate for sustainability.

But, as the controversy over preservation of old growth and the owl demonstrated, these statutes provided an inadequate framework for considering the full array of relevant values and facts. Decisions under the

11. *Hearings on "How Safe is Safe Enough?: Risk Assessment and the Regulatory Process" Before the U.S. House of Representatives Comm. on Science, Space & Technology, Subcomm. on Investigations and Oversight*, 103d Cong., 1st Sess. 4 (1993) (testimony of John A. Moore, President, Institute for Evaluating Health Risks).

12. 16 U.S.C. §§ 1531-1544 (1988 & Supp. IV 1992). The ESA generally requires designation of critical habitat for listed species and accords these areas protection. 16 U.S.C. § 1533 (1988).

13. The ESA provides for consideration of the competing interests affected by species and habitat preservation through the habitat designation process and the exemption process. *Id.* §§ 1533(b), 1536(h).

ESA and other applicable laws have not ended the controversy. Instead, the national attention attracted to the controversy has given rise to decision-making vehicles outside the statutory processes.[14] In these fora, decision makers and the public have considered the changing profile of a regional culture and economy, international trade policies, long-standing public land management practices, and the nature of the ecosystem, as well as the many values represented not only by the owl but also by the ancient forests. Many of these facets of the dispute were largely irrelevant under the applicable statutes.[15]

The shortcomings of our statutory framework are understandable, in that the ESA and our public land management laws were not designed with ecosystem preservation or regional economic transitions in mind.[16] And the analytic techniques upon which we have traditionally relied, such as quantitative cost-benefit analysis, perform poorly in valuing resources over a relatively long period of time. The question this raises is how to account for the broader dimensions of conflicts between endangered species—and ecosystems—and economic activity. Not only will an analysis better tailored to such controversies be complex, but significant gaps in our understanding of the relevant systems and phenomena are inevitable. As we come to understand the complexity, we inevitably also see new boundaries of our knowledge and understanding.

One obvious response is to broaden statutes' scope as necessary to ensure consideration of all relevant factors.[17] Such measures will undoubtedly contribute to the improvement of our laws. But this Essay focuses on a different facet of our response: improving the analytic methods employed in regulatory decision making in response to the twin challenges of complexity and uncertainty.

Traditional quantitative cost-benefit analysis has provided and can continue to provide helpful information for assessing the trade offs involved in environmental disputes. But we know that not all benefits can

14. These include the so-called Timber Summit of 1989, *see* Bryan M. Johnston & Paul J. Krupin, *The 1989 Pacific Northwest Timber Compromise: An Environmental Dispute Resolution Case Study of a Successful Battle That May Have Lost the War*, 27 WILLAMETTE L. REV. 613 (1991), and the conference in April 1993, attended by President Clinton and Vice President Gore, *see* Timothy Egan, *Clinton Under Crossfire at Logging Conference*, N.Y. TIMES, Apr. 3, 1993, at A6. These laws suffered much criticism for their failure to address relevant issues. *See* Alyson C. Flournoy, *Beyond the "Spotted Owl Problem": Learning from the Old-Growth Controversy*, 17 HARV. ENVTL. L. REV. 261, 316-18 (1993).

15. *See* Flournoy, *supra* note 14, at 316-18.

16. *See id.* at 301-06.

17. See Lakshman Guruswamy, *Integrating Thoughtways: Reopening of the Environmental Mind?*, 1989 WIS. L. REV. 463, for a useful discussion of the problems caused by fragmentation in our statutory framework and some proposed solutions.

be quantified adequately, and that economic valuation can provide little guidance on the value of resources over a long period of time. So important normative judgments must be made in resolving controversies over resource use that quantitative cost-benefit analysis cannot cover.[18] We must at least question, in light of our richer understanding of the complexities involved, whether existing statutes and the current applications of quantitative techniques—such as cost-benefit analysis—under these laws provide a sufficient framework for addressing the more complex array of facts and values.

When fundamental value choices must be made among preservation of unique ecosystems—for the services they perform as well as their inherent value—and short- and long-term economic impact on individuals and a region with due regard for the role in the conflict played by international trade policies, industry management decisions, and historic government practices in public land management, traditional applications of cost-benefit analysis may be inadequate. To integrate the multiplicity of variables and systematically evaluate the impact of various policy options may demand more sophisticated applications of cost-benefit analysis that can coherently integrate both quantifiable and nonquantifiable values. The analysis must be able to accommodate a certain degree of what we might call vagueness or fuzziness.[19] The best analytic tool may not be one that produces a single, neat answer in quantitative form—which may mask important value choices—but a method that informs decision makers and the public about what policy options are available in light of what

18. For a discussion of some of the shortcomings of strict cost-benefit analysis as a tool for guiding action in the case of the spotted owl, see BARRY S. MULDER ET AL., U.S. FISH AND WILDLIFE SERV., EXCLUSION PROCESS: CRITICAL HABITAT AND THE NORTHERN SPOTTED OWL 4 (1992) (noting that Congress has stated that value of species is "incalculable"; that preservation, off-site and intrinsic benefits of species preservation are not traded in markets and thus are difficult to value; that cost-benefit analysis does not incorporate distributional concerns; and that uncertainties preclude accurate estimation of impact of incremental regulatory decisions on value associated with species). *See also* M.L. SCHAMBERGER ET AL., ECONOMIC ANALYSIS OF CRITICAL HABITAT DESIGNATION EFFECTS FOR THE NORTHERN SPOTTED OWL 68-77 (1992) (providing discussion of various benefits of critical habitat designation and noting that comprehensive dollar estimates of many benefits are impossible with available data); RELATIVE RISK REDUCTION STRATEGIES COMM., U.S. ENVTL. PROTECTION AGENCY, REDUCING RISK: SETTING PRIORITIES AND STRATEGIES FOR ENVIRONMENTAL PROTECTION 8 (1990) [hereinafter REDUCING RISK] (noting that quantitative methodologies which discount value of natural resources in future are incompatible with goal of sustaining economic development over time, and that some subjective value judgments must be made in prioritizing risk which cannot be quantified).

19. I borrow this term from the field of computer science, where recent applications of "fuzzy logic" have permitted engineers to design computer programs that go beyond binary approaches to "paint gray, commonsense pictures of an uncertain world." Bart Kosko & Satoru Isaka, *Fuzzy Logic*, SCI. AM., July 1993, at 76.

science and economics can tell us.[20] Such a method will permit us to make the best-informed choices in light of the complexity we confront, neither reducing it to an artificial simplicity nor allowing it to paralyze us.

What would such a method look like? How would it differ from traditional quantitative analysis supplemented by an ad hoc balancing of unquantified factors? Following is a brief description of an approach developed by scientists and resource economists that responds to similar problems in the context of wetlands permitting decisions. It does not provide an easy or complete answer to the problems outlined above, but it suggests a direction that we may need to pursue in the years ahead.

B. *The Application of Multiple Alternative-Multiple Attribute Analysis to Wetlands Permitting Decisions*

Section 404 of the Clean Water Act of 1977 and the implementing regulations require that applications to dredge or fill wetlands be evaluated under both the Army Corps of Engineers' broad "public interest" balancing test and the Environmental Protection Agency's (EPA's) section 404(b)(1) water quality guidelines.[21] This involves an analysis somewhat similar to the analysis under the resource protection statutes described above, in that it entails a general weighing of the costs and benefits associated with decisions concerning natural resource use. Traditional cost-benefit analysis can be a useful tool in assessing the relative values at stake in these decisions. However, our evolving understanding of wetlands ecosystems has made us aware that we do not yet fully understand the functioning of wetlands or the role they play in relation to neighboring ecosystems. Traditional cost-benefit analysis may permit us to account for the value of an identified wetland parcel in isolation from the ecosystem. Yet this approach excludes values we know to be associated with the wetland in its larger environmental context. We are still far from being able to quantify all the values that may be affected by wetlands alteration.[22]

---

20. *See* MULDER ET AL., *supra* note 18, at 4.

21. 33 U.S.C.A. § 1344 (West 1986 & Supp. 1993); 40 C.F.R. § 230.11 (1993); 33 C.F.R. § 320.4 (1993).

22. For example, efforts to quantify the value of a foregone sensory or recreational experience, the cultural value of a resource—such as its potential to support educational research or to provide artistic inspiration—the value of natural services provided by an ecosystem or a wetland, or the option or inheritance value of a lost natural resource—such as a species or a type of forest—are controversial at best. *See* Clyde F. Kiker & Gary D. Lynne, *Wetlands Values and Valuing Wetlands, in* ECOLOGY AND MANAGEMENT IN TIDAL MARSHES: A MODEL FROM THE GULF OF MEXICO (C.L. Coultas & Y.P. Hsieh eds., forthcoming 1994)

In the face of this uncertainty and complexity, we can fall into the trap of reductionism, quantifying some values and ignoring those we cannot fully understand or quantify. We can try to improve on this by including a laundry list of unquantified values, but the task of weighing apples and oranges is clumsy and imprecise. Under section 404 review the difficulties in integrating these incommensurables is all the more apparent due to the involvement of two agencies and the tension inherent in balancing the relatively precise values comprehended in the EPA water quality evaluation[23] and the fuzzier Corps public interest review.[24] One danger is that the shiny quantifiables may always appear weightier than the fuzzy, less tangible values. Moreover, the comparison of dollar and nondollar values may be poorly explained and thus poorly understood by the public, if it is not part of a systematic analysis.[25] We can simplify our analysis by focusing only on the values found within the relevant parcel of wetland, but then we ignore the more complex and less well known ecosystemic values affected by alteration of the wetland, which may be of substantial public importance.

Resource economists considering this dilemma have explored analytic techniques that bridge this gap. A working group convened by the EPA and Army Corps of Engineers suggested techniques for systematic identification and assessment of the values affected by wetlands alteration, including those values that evade quantification.[26] This application of cost-benefit analysis takes a holistic approach, incorporating the impacts of wetland alteration on the uses and values of surrounding natural

(manuscript at 10-11, on file with *Loyola of Los Angeles Law Review*). Whether such quantification is possible remains a subject of debate. Some resource economists have concluded that a wetlands permitting policy based on a cost-benefit balancing test is technically impractical. *See id.* (citing sources); *see also* MULDER ET AL., *supra* note 18, at 4 (detailing reasons that cost-benefit ratio should not determine critical habitat designation); SCHAMBERGER ET AL., *supra* note 18, at 69 (stating comprehensive dollar estimate of benefits of critical habitat designation not feasible with available data).

23. These include impact on water circulation, fluctuation and salinity, and containment levels. They also include assessment of less readily quantified variables, such as impacts on the ecosystem. 40 C.F.R. § 230.11.

24. The public interest review entails consideration of, inter alia, conservation, aesthetics, general environmental concerns, wetlands, and fish and wildlife values. It also requires the agency to consider reasonable alternatives to the proposed activity, detrimental effects on other uses, and need. 33 C.F.R. § 320.4(a).

25. *Cf.* Kiker & Lynne, *supra* note 22 (manuscript at 11-12) (advocating decision-making methodology that organizes information on all values affected, so that consequences of action can be fully understood by decision makers and the public).

26. *See* Clyde F. Kiker et al., *Analysis of Impacts of Site-Altering Activities on Bottomland Hardwood Forest Uses: The Report of the Cultural/Recreational/Economic Workgroup, in* ECOLOGICAL PROCESSES AND CUMULATIVE IMPACTS (James G. Gosselink et al. eds., 1990) (manuscript on file with *Loyola of Los Angeles Law Review*).

areas, as well as the more obvious values within the boundaries of the parcel.[27] It accepts the current limitations of quantitative methods and seeks to develop complementary methodologies to account for these.[28]

A methodology of this type was used in a controversial regulatory decision involving wetlands in the Green Swamp in central Florida.[29] Resource economists, building on the principle of multiple alternative-multiple attribute evaluation, developed information on existing uses of the area and the impact of proposed alterations on these uses. The analysts developed a series of arrays or charts that showed graphically how six alternative uses of the relevant wetlands correlated to a variety of values, some of which were difficult to measure quantitatively.[30] When quantification was not appropriate, the arrays indicated whether the correlation was positive, negative, uncertain, or nonexistent. This provided a systematic framework within which all interested parties were able to assess the impact of the alternatives on various values. The process went beyond commonly employed forms of cost-benefit analysis in accommodating the complexity of the natural systems and human values involved. The analysis avoided the illusory precision of a strained quantification, and presented the qualitative information that was available in a systematic format, providing a clearer view of the policy choices to be made. Multiple alternative-multiple attribute evaluation provided decision makers and members of the public an accessible summary of the net impact of various alternative uses of the wetland parcel.[31]

Multiple alternative-multiple attribute analysis is not a radical departure from the methods commonly employed in wetlands decisions. Indeed it is a form of cost-benefit analysis. The question is whether it moves us in the direction of better or more efficient decision making. Several features of the analysis are significant in this regard. First, the analysis encourages and facilitates consideration of more than two options—thus moving beyond the limiting permit-no permit framework and presenting decision makers and the public with information on a variety of uses, providing a broader frame of reference.[32] Second, multiple alternative-multiple attribute analysis facilitates systematic compari-

27. *Id.* (manuscript at 6-11).
28. *Id.* (manuscript at 32).
29. *See* Kiker & Lynne, *supra* note 22 (manuscript at 19-22).
30. *See id.* (manuscript at 14-16, 20-22).
31. *Id.* (manuscript at 21-22).
32. For example, the alternatives evaluated might include conversion of the area to two different agricultural crops, such as soybeans and rice, channelization of a stream adjacent to the site, levee construction on the site, or conversion to pine plantation or aquaculture. *See* Kiker et al., *supra* note 26 (manuscript at 11, tbls. 4-8).

son of the impact of two or more options on nonquantifiables, such as aesthetic and cultural values—something not as easily accomplished by an unstructured narrative discussion of such values. Third, consideration of the cumulative impact of the options on a variety of nonquantified values is facilitated by the systematic nature of the analysis of these values.

These attributes of multiple alternative-multiple attribute analysis facilitate comparison and more rational selection among options, notwithstanding the complexity and uncertainty associated with the decision. This is not to suggest that multiple alternative-multiple attribute analysis or any other particular technique is a panacea for the problems associated with resource use decisions. Serious challenges face decision makers under this methodology as well.[33] The more basic point is not that we should adopt this analytic technique, but that opportunities exist to improve our decision making. Lawmakers and regulators must maintain a broad focus and pay attention to opportunies to cope with uncertainty and complexity.

III. Uncertainty and Complexity in Toxics Regulation

A. Lessons from the Past

A second illustration of the shortcomings of our current regulatory process when confronted with complexity and uncertainty comes from the field of toxics regulation. Regulatory progress in addressing the threat posed by toxics has been widely criticized as exceedingly slow. Under most of our statutory standards, regulation proceeds only when we have a degree of certainty about the risks that closely approximates the standards of scientific research—a relatively rare occurrence. We know very little about most substances, and the slow pace of progress

---

33. First, this holistic and broader analysis still does not define the relevant values to be considered. Choices must be made among attributes to be included. These are difficult political questions currently, and they will remain so in the future. But it is noteworthy that we make these decisions when we apply currently employed methodologies; we simply make them in a less visible, systematic way. Experience suggests that the lack of focus on these normative questions may make the ultimate regulatory decisions more controversial, not less so. *See supra* p. 811. An analysis with more visible and systematic value choices may help to focus public debate on the important question of what values are relevant.

Second, multiple alternative-multiple attribute analysis does not eliminate the tension between quantified and unquantified variables. But the point is not perfection. If we know that current applications of cost-benefit analysis fail to compensate adequately for the shortcomings of quantitative analysis, then we should remain alert for opportunities to improve our decision-making structure incrementally, by moving toward more systematic consideration of nonquantified values. Multiple alternative-multiple attribute analysis is an example of such an opportunity.

under existing statutes suggests that we will be unable to act on many of them in the near future. Regulatory priorities are thus often developed with inadequate knowledge about the potential danger of the many untested substances.

Many have raised questions about the balance that our statutes strike between the dangers of over- and under-regulation in this area of extreme uncertainty.[34] Forceful arguments have been made for greater consideration of the question of how to make policy decisions in this climate of uncertainty.[35] Assessing the value of quantitative risk assessment and other techniques in the regulatory context and refining their applications will be important steps in responding to this challenge.[36]

A second important theme in toxics regulation is the failure of our current laws to address the more complex dimensions of chemical effects on health and the environment, such as the possibilities of cumulative and synergistic impacts and noncancer impacts. We continue to operate under a regime that envisions substance-by-substance testing for cancer risk, ignoring the possibility that synergistic, cumulative, and noncancer effects may represent a far more significant threat to health and the environment. Great weight is given to the seemingly precise quantitative risk assessments that agencies develop, sometimes with inadequate attention to the limited precision of such numbers[37] and the many dimensions of human and environmental health risk for which they fail to account.[38]

34. Some recent reforms, such as the 1990 amendment of section 112 of the Clean Air Act, 42 U.S.C. § 7412 (Supp. III 1991), represent an effort to achieve progress in controlling toxics by shifting from a quality-based to a technology-based standard.

35. *See, e.g.*, Howard A. Latin, *The Feasibility of Occupational Health Standards: An Essay on Legal Decisionmaking Under Uncertainty*, 78 NW. U. L. REV. 583 (1983); Howard A. Latin, *The "Significance" of Toxic Health Risks: An Essay on Legal Decisionmaking Under Uncertainty*, 10 ECOLOGY L.Q. 339 (1982); *cf.* Peter Huber, *Safety and the Second Best: The Hazards of Public Risk Management in the Courts*, 85 COLUM. L. REV. 277 (1985) (arguing that public regulation of risk is biased against many progressive, risk-reducing technologies).

36. The recent report of the Carnegie Commission Task Force on Science and Technology in Judicial and Regulatory Decisionmaking represents an important contribution to this process. In the report, CARNEGIE COMM'N ON SCIENCE, TECHNOLOGY, AND GOV'T, RISK AND THE ENVIRONMENT: IMPROVING REGULATORY DECISION MAKING (1993) [hereinafter RISK AND THE ENVIRONMENT], the task force makes extensive recommendations on agency decision-making processes and the use of tools such as quantitative risk assessment. This builds on earlier work done by the EPA under Administrator Reilly. *See generally* REDUCING RISK, *supra* note 18 (Science Advisory Board report reviewing data and methodology supporting risk assessment, comparison, and reduction, and presenting policy recommendations).

37. *See* RISK AND THE ENVIRONMENT, *supra* note 36, at 78; James P. Leape, *Quantitative Risk Assessment in Regulation of Environmental Carcinogens*, 4 HARV. ENVTL. L. REV. 86, 103-13 (1980).

38. The recent debate about comparative or relative risk assessment again raises this issue. Even supporters of relative risk assessment note that all relevant dimensions of a given risk cannot be summarized in a single ratio, and that our ability to quantify risks is limited. Thus,

The history of toxics regulation illustrates how statutes and analytic techniques that fail to account for complexity and uncertainty can distort regulation. Like Scylla and Charybdis, complexity and uncertainty threaten to block regulatory progress. The proliferation of complex questions and the impossibility of complete and certain answers to them can paralyze us like the many heads of Scylla, forcing us to turn back to the sheltering harbor of the status quo. Swerving to avoid this danger, we must also avoid the whirlpool of reductionist analyses, in the vortex of which problems are oversimplified to produce distorted but neat conclusions.

Charting a course between these two extremes is not easy. Such a path requires us to make judgments about the cost of under- and over-regulation and about the limits of our understanding, in light of the values that impel us to undertake regulation in the first place.[39] It requires that we accept and build on that which science can tell us, while recognizing the limits of its value. When we reach those limits, we must find systematic and coherent strategies for policy choices.

A recent regulatory initiative offers an example of how regulators can minimize regulatory paralysis by considering both what science can and cannot tell us. Using this knowledge we can develop processes in which we make the best possible use of information, mindful of its limitations.

B. The Use of Expedited Risk Assessment is a Priority-Setting Device in Toxics Regulation

An important focus for reform of toxics regulation is statutory standards of proof.[40] Drawing on insights from philosophy, law, epidemiol-

---

they are cautious in evaluating the role comparative risk ratios will play in determining regulatory priorities. *See generally* REDUCING RISK, *supra* note 18, at 19-20, 27, 31, 36-39; *Forum: Should We Set Priorities Based on Risk*, EPA J., Mar.-Apr. 1991, at 17-51. Critics raise the more trenchant objection that relative risk assessment may supplant democratically determined norms with scientists' moral judgments. *See* Donald T. Hornstein, *Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis*, 92 COLUM. L. REV. 562, 629-33 (1992).

39. For a discussion of the importance of identifying these policy goals as we evaluate regulatory approaches, see Christopher H. Schroeder, *In the Regulation of Manmade Carcinogens, If Feasibility Analysis Is the Answer, What Is the Question?*, 88 MICH. L. REV. 1483, 1502-05 (1990).

40. *See* Alyson C. Flournoy, *Legislating Inaction: Asking the Wrong Questions in Protective Environmental Decisionmaking*, 15 HARV. ENVTL. L. REV. 327, 360-66 (1991) (stating current standards of proof place unrealistic demands on science to produce single, correct conclusion); *see also* sources cited *supra* note 35 (citing works of Howard A. Latin).

ogy, and toxicology, philosopher Carl Cranor[41] has evaluated the impact of standards of proof and scientific assumptions currently employed by regulators on the regulatory enterprise. In *Regulating Toxic Substances*, he examines the policies embedded in scientific assumptions and standards of proof.[42] The question he poses is whether these assumptions and standards are appropriate to the context of toxic substances regulation.

This work grew out of his recognition that not every regulatory decision need be made with the same degree of certainty chosen by research science.[43] Indeed, not every decision made by scientists is based on this degree of proof. Cranor explores the possibilities of a relatively quick and inexpensive scientifically recognized technique known as expedited risk assessment.[44] He concludes that for purposes of some regulatory decisions—such as decisions to issue warnings and priority setting—we may do better relying on expedited risk assessments rather than acting with no basis for judging the risks of the many untested substances, paralyzed by the cost and time required to know the impacts of the many untested substances with ninety-five percent certainty.[45] Cranor has since worked with regulators in California to explore the use of expedited risk assessment as a tool for obtaining enough certainty about the potential risks of chemical substances to support a more rational ordering of regulatory priorities.

Inherent in Cranor's approach is an acceptance of the complexity and uncertainty that limit our understanding of toxic substances. Rather than assuming that inaction is the only course possible until we have sufficient proof to support scientific certainty, it distills what science can tell us and tries to employ that knowledge in a way that achieves our policy goals. Nor does the initiative seek to oversimplify the problem presented by toxics. The simplification of the process is carefully tailored

41. Professor Cranor has had significant exposure to both the law and science of toxic substances. He was a Master in Studies of Law Fellow at Yale Law School, and worked both as a legislative aide to Representative George Brown (then a member of the House Committee on Science, Space and Technology) and with the Office of Technology Assessment as a congressional Fellow. He has also served as a member of the California Proposition 65 Science Advisory Panel.

42. CARL F. CRANOR, REGULATING TOXIC SUBSTANCES: A PHILOSOPHY OF SCIENCE AND THE LAW 25-48 (1993).

43. Cranor examines in detail the problems with wholesale adoption of a "science intensive" approach—one that demands adherence to the standards of scientific research. *Id.* at 116-29.

44. *Id.* at 137-51.

45. Cranor concludes with a chapter discussing the epistemic and moral justification for this approach. *Id.* at 152-78.

to its context: An important consideration in the work was developing a process that reflects and will better achieve the policies that motivate the relevant regulatory decisions.[46] The end result is an analytic method that can help us to make better informed policy choices in light of the complexity and uncertainty we face. Lawmakers and regulators seeking to improve regulation should seek out similar methods, evaluate their potential for improving regulatory decisions, and facilitate their implementation.

IV. CONCLUSION

Systematic evaluation of the analytic tools used in environmental regulation can improve our regulatory decisions in many ways. Given our commitment to scientific rationality as the foundation for our policies, we cannot afford to misuse science or to employ analyses that deny the complex richness of the environment or the human values at stake. We must consider how well the tools on which we base our policies account for the complexity of our world and the limits of our understanding.

There may be other benefits from ensuring that our policies are chosen with a proper respect for complexity and uncertainty. Analytic techniques that present what we know while acknowledging the limits of our knowledge more clearly present the policy or value choices involved in regulatory decisions. Such methods tend to make regulatory decisions more accessible to the public and thus more democratic.[47] Reductionist methods that pretend to an illusory scientific accuracy tend to obscure the relevant policy choices from public view.[48] Avoiding illusory precision may improve regulators' accountability. This may help to improve public confidence and acceptance of regulatory decisions.[49]

46. *Id.* at 146. Lawmakers, regulators, or others evaluating the need for reform may differ with Cranor on the precise balance of policies embedded in the relevant statutes, and thus reach a different conclusion about the propriety of relying on expedited risk assessment for priority setting. Nonetheless, the analysis Cranor offers in support of the use of expedited risk assessment for priority setting suggests a fruitful framework in which to evaluate regulatory reforms in this area. If one agrees that current methods for setting regulatory priorities fail to account for all that science can usefully tell us because assumptions embedded in regulatory standards of proof do not conform to the values expressed in our statutes, then it makes sense to pay greater attention to evolving techniques in which assumptions and constraints may better comport with regulatory values.

47. *See* Kiker & Lynne, *supra* note 22 (manuscript at 12, 20).

48. *See* RISK AND THE ENVIRONMENT, *supra* note 36, at 87-90.

49. This was apparently the case with the Green Swamp decision. *See* Kiker & Lynne, *supra* note 22 (manuscript at 21-23).

Clearer analysis of the factual and normative issues may also promote greater public responsibility for policy choices. Regulatory decisions that oversimplify the choices involved, disguise relevant policy choices as science, or favor the status quo automatically when faced with a certain level of complexity or doubt encourage public hostility. Greater public understanding of the factual and normative conflicts embedded in regulatory policy will not overcome the human tendency to blame others for intractable problems and difficult choices, but it may facilitate public acceptance of responsibility for the trade offs that our regulatory policies demand.[50]

Finally, although better tools for coping with complex and uncertain questions will not eliminate the controversy over the policy decisions to be made, they may reduce the pressure on agencies to justify as "science" decisions that science does not demand.

We cannot avoid the complexity that we have belatedly realized surrounds us. Our competing demands for the environment in its unspoiled state and use of its raw materials will continue to create environmental conflicts. The ever-increasing pressures of population growth and demands for higher standards of living make it critical that we consider the consequences of our policies clearly, that we make choices based on what we know, but always mindful of that which we do not.

50. Former EPA Administrator William Ruckelshaus's efforts to improve risk communication and involve members of affected communities in decisions regarding hazardous waste clean ups were premised in part on this notion. *See* William D. Ruckelshaus, *Science, Risk, and Public Policy*, 221 SCI. 1026, 1028 (1983); William D. Ruckelshaus, *Risk, Science, and Democracy*, ISSUES SCI. & TECH., Spring 1985, at 19.