Embracing Uncertainty, Complexity, and Change: An Eco-pragmatic Reinvention of a First-Generation Environmental Law

*Mary Jane Angelo**

These sprays, dusts, and aerosols are now applied almost universally to farms, gardens, forests, and homes—nonselective chemicals that have the power to kill every insect, the “good” and the “bad,” to still the song of birds and the leaping of fish in streams, to coat the leaves with a deadly film, and to linger on in soil—all this though the intended target may be only a few weeds or insects. Can anyone believe it is possible to lay down such a barrage of poisons on the surface of the earth without making it unfit for all life?¹

If Rachel Carson were alive today I believe she would give America a mixed grade.²

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* Assistant Professor of Law, University of Florida Levin College of Law. I would like to thank: Professors J.B. Ruhl, Holly Doremus, Alyson Flournoy, Lyrrisa Lidsky, Diane Mazur, Barbara Woodhouse, Mark Fenster, Jeff Harrison, and Thomas Cotter for helpful comments, guidance, and encouragement; Meredith Fields and Drew Melville for research assistance; and the University of Florida Summer Research Grant Program for financial assistance.

1. RACHEL CARSON, *SILENT SPRING* 7–8 (40th anniv. ed., First Mariner Books 2002).

2. E.O. WILSON, *Afterword* of RACHEL CARSON, *SILENT SPRING* 362 (40th anniv. ed., First Mariner Books 2002).

Recent scientific reports demonstrate that despite more than thirty years of environmental regulation, bird and wildlife species as well as ecosystem services, are in unprecedented decline. Pesticides are at least in part to blame for these profound declines. U.S. pesticide law has failed to carry out its mission of environmental protection. A number of recently-filed lawsuits assert that the registration of certain pesticides violates the federal Endangered Species Act. One of the great ironies of environmental law is that the ecological consequences of pesticide use, which fueled the environmental movement of the late 1960s and early 1970s, largely have been ignored for the past thirty years. Only recently has interest renewed in the ecological (as opposed to human health) risks posed by pesticides. Moreover, the explosion of pesticidal—genetically modified organism (GMO) use in agriculture raises concerns regarding the novel risks to biodiversity posed by these new pesticides. Surprisingly, however, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) has not changed significantly with regard to ecological matters since 1972 and remains primarily a consumer protection statute not well-suited for ecological protection. The Environmental Protection Agency's (EPA) implementation of FIFRA has not kept pace with our developing understanding of the uncertainty, complexity, and changing nature of ecological systems. This Article breaks new ground by being the first to use the new legal discipline of "eco-pragmatism" to analyze, and then reinvent, U.S. pesticide law to better protect ecological resources.

For years, environmental legal scholars have sought a middle ground between absolutist risk-based approaches to environmental regulation and cost/benefit analysis approaches. In the past several years, scholars have begun exploring the emerging field of eco-pragmatism—a dramatic new framework for environmental decision-making developed by Professor Daniel Farber—to achieve a workable middle ground. Although a number of prominent legal scholars have analyzed eco-pragmatism in a general sense, none have applied an eco-pragmatic framework to any environmental pollution control law. This Article is the first to do so. This Article builds on Farber's work and others by first bolstering eco-pragmatism through consciously incorporating principles of ecological science and then applying the strengthened eco-pragmatism to a long-overlooked area, pesticide law. As the first application of eco-pragmatism to a field of environmental pollution control law, this Article is an important step in the development of this area of legal theory. By analyzing current pesticide law as well as EPA's implementation of such law through an eco-pragmatic lens, this Article identifies areas of the law in need of revision and proposes revisions based on eco-pragmatic principles, which if implemented would greatly enhance our ability to protect critical ecological resources.

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INTRODUCTION

If you heard a strange rumbling sound in late 2004, it may have been Rachel Carson rolling over in her grave in response to the National Audubon Society's alarming "State of the Birds" report.³ The report

3. In the fall of 2004, the National Audubon Society ("Audubon") published its State of the Birds USA 2004 report in Audubon magazine (hereinafter *Report*). NAT'L AUDUBON SOC'Y, STATE OF THE BIRDS USA (2004), <http://www.audubon.org/bird/stateofthebirds/>. In the Report, Audubon evaluated the status of 654 bird species native to the continental United States. The species evaluated inhabit the nation's four major types of natural habitat—grass, shrubs, tree, and water. *Id.* The report revealed a very disturbing trend: large percentages of bird species utilizing all of these habitats are in significant decline. The declines range from 13 percent to 70 percent depending on the habitat type used by the species. Press Release, Audubon Society, Audubon 'State of Birds' Report Reveals America's Birds are in Trouble (Oct. 19, 2004), http://www.audubon.org/news/press_releases/1004-SOTB_10-19-04.html. In addition to the Audubon report, another significant report on the decline of bird species

concludes that despite all of the environmental laws, regulations, polices, and programs established since Rachel Carson first sounded the environmental alarm, a large percentage of avian species found in the continental United States are in a significant state of decline.⁴ While pesticides are only one of the many causes implicated in the bird population declines,⁵ the fact cannot be ignored that despite Carson's dire warnings, and more than thirty years of intensive regulation, pesticides continue to pose significant risks to birds, other wildlife, and ecosystems in general.

One of the great ironies of environmental law is that the ecological consequences of pesticide use, such as the devastating impacts of DDT on predatory bird populations, which fueled the environmental movement of the late 1960s and early 1970s, largely have been ignored for the past thirty years. Only recently has interest renewed in the ecological (as opposed to human health) risks posed by pesticides.⁶ Moreover, the explosion of pesticidal genetically modified organism (GMOs) use in agriculture raises concerns regarding the novel risks to biodiversity posed by these new pesticides. Surprisingly, however, the primary federal statute governing pesticides, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA),⁷ has not changed significantly with regard to ecological matters since 1972 and remains primarily a consumer protection statute not well-suited for ecological protection. Moreover, the manner in which the Environmental Protection Agency (EPA) has implemented FIFRA has not kept pace with our developing understanding of the uncertainty, complexity, and changing nature of ecological systems.

For years, environmental legal scholars have sought a middle ground between absolutist risk-based approaches to environmental regulation and cost/benefit analysis approaches. In the past several years, scholars have begun exploring the emerging field of eco-pragmatism—a

conducted by researchers at Stanford University was published in the Proceedings of the National Academy of Sciences in 2004. Cagan H. Sekercioglu, Gretchen C. Daily & Paul R. Ehrlich, *Ecosystem Consequences of Bird Declines*, 101 PROC. NAT'L ACAD. SCI., 18042–47 (2004). This report predicts that by the year 2100, 10 percent of all bird species are likely to disappear and that another 15 percent could be on the brink of extinction. *Id.* Moreover, The Center for Biological Diversity recently released a report that found EPA has approved registrations for pesticides that put more than 375 Endangered Species Act (ESA) listed species at risk. BRIAN LITMANS & JEFF MILLER, CTR. FOR BIOLOGICAL DIVERSITY, SILENT SPRING REVISITED: PESTICIDE USE AND ENDANGERED SPECIES (2004), <http://www.biologicaldiversity.org/swcbd/Programs/science/pesticides/REPORT.pdf>.

4. *Report*, *supra* note 3.

5. The report identifies habitat loss as the leading cause of bird declines, with other factors, such as pesticide poisoning, contributing to the declines. *Id.*

6. *See, e.g.*, Wash. Toxics Coalition v. EPA, No. C01-013132C (W.D. Wash. Jan. 22, 2004), *available at* <http://www.epa.gov/espp/wtc/index.html>.

7. 7 U.S.C. §§ 136–136y (2000).

framework for environmental decision-making developed by Professor Daniel Farber—to achieve a workable middle ground. At the same time, scholars have begun to look at environmental law through the lens of ecological science. Common themes of complexity, uncertainty, and change permeate both eco-pragmatism and ecological science. Science has only scratched the surface of understanding complex ecological systems. What little is understood about ecological science teaches us that ecological systems are extremely complex and ever changing. Eco-pragmatism seeks to address concerns with complexity, uncertainty and change. By incorporating ecological science into eco-pragmatism, these challenging issues can be addressed more effectively. Accordingly, an integrated approach drawing on the discipline of ecology—the study of the interactions of living organisms and their environments—and eco-pragmatism can provide a comprehensive framework to protect ecological resources through environmental regulation. To date, no significant attempts have been made to analyze FIFRA,⁸ and only a few attempts have been made to comprehensively analyze any other traditional pollution control law, under eco-pragmatism or principles of ecological science.⁹

Pesticide law, perhaps more than any other pollution control law, lends itself to such eco-pragmatic analyses. Since 1972 when FIFRA was amended to take environmental concerns into account, considerable advances have been made in the ecological sciences. Because FIFRA regulates through national registration of products, risks are assessed on a one-time nationwide basis. Accordingly, localized ecological concerns are not considered. Moreover, pesticide regulation is unique in that, unlike other areas of environmental protection where environmental laws can seek to eliminate or minimize hazardous releases that result as unintended consequences of manufacturing or other processes, pesticides are intentionally released into the environment for the express purpose of killing, injuring, or disrupting the behavior of living organisms in the environment. In other words, simply keeping pesticides out of the environment is not an option. Consequently, the complexity and uncertainty manifest in ecological systems, as well as the disequilibria inherent in such systems, must be considered in any system designed to

8. In fact, very few scholarly efforts have been made to analyze FIFRA in any comprehensive way at all. For one of the more comprehensive scholarly works, see Donald T. Hornstein, *Lessons From Federal Pesticide Regulation on the Paradigms and Politics of Environmental Law Reform*, 10 YALE J. ON REG. 369 (1993) (using an analysis of FIFRA to frame an argument for an alternative framework for environmental law reform, which more aggressively addresses the causes of environmental problems, rather than relying on risk-based priority setting).

9. One recent attempt to analyze the Clean Water Act, 33 U.S.C. §§ 1251–1387 (2000), using ecological principles is Robert W. Adler, *The Two Lost Books in the Water Quality Trilogy: The Elusive Objectives of Physical and Biological Integrity*, 33 ENVTL. L. 29 (2003).

address ecological risks posed by pesticides. This Article advances eco-pragmatism by consciously integrating ecological science into an eco-pragmatic framework. In addition, by employing eco-pragmatism's inherent experiential approach, this Article utilizes experience gleaned from over thirty years of U.S. policy on pesticide regulation to propose improvements to pesticide regulation within an eco-pragmatic framework.

Part I of this Article provides an analysis of eco-pragmatic theory, demonstrates the need for theory to better integrate ecological concerns, and shows how ecological principles can further develop and support eco-pragmatism. Part II lays out the history of ecological issues in pesticide regulation and highlights the areas where current pesticide law does not adequately address ecological concerns. The ecological risks posed by traditional synthetic chemical pesticides and pesticidal genetically modified organisms are set forth. Part II further demonstrates that for pesticide regulation in particular, it is imperative to expand the role of ecological considerations. Part III describes current U.S. pesticide law and its application. Part IV evaluates FIFRA from an eco-pragmatic perspective and concludes that, although some components of the statute are surprisingly eco-pragmatic, substantially more could be done to use eco-pragmatic theory to improve FIFRA's ability to protect ecological integrity. Finally, Part V proposes a new eco-pragmatic approach to pesticide regulation.

I. ECO-PRAGMATISM

A. *The Historical Roots of Pragmatism*

The roots of eco-pragmatism can be traced to early twentieth century philosophical pragmatism.¹⁰ In its broadest sense, pragmatism is a philosophy that relies on action, experimentation, and workable solutions, rather than theoretical constructs.¹¹ An aspect of philosophical

10. Philosophical pragmatism has been applied over the years to a variety of disciplines. For example, Oliver Wendell Holmes is credited with developing legal pragmatism, an attempt to apply pragmatism to legal theory. Legal pragmatism grew out of Holmes' belief that the law evolves out of experience rather than logic. Other proponents of legal pragmatism include Benjamin Cardozo and Richard Posner. See Joel A. Mintz, *Some Thoughts on the Merits of Pragmatism as a Guide to Environmental Protection*, 31 B.C. ENVTL. AFF. L.REV. 1, 9-13 (2004).

11. For a good discussion of early philosophical pragmatism, see generally Mintz, *supra* note 10. Philosophical pragmatism rejects dogma and particular outcomes in favor of a method of using experience and experimentation to determine what "works." *Id.* at 1. In pragmatism, decisions are measured by their consequences and the extent to which they fulfill the needs of society. Pragmatism has been described as emphasizing "practice over theory." See J.B. Ruhl, *Working Both (Positivist) Ends Toward a New (Pragmatist) Middle in Environmental Law*, 68 GEO. WASH. L. REV. 522, 531 (2000) (book review). Pragmatists believe that the value of an idea

pragmatism particularly relevant to integrating ecological principles into environmental law is pragmatism's flexibility, which is rooted in acceptance of indeterminacy and the limitations of human understanding.¹² Pragmatists embrace the idea that as more knowledge becomes available and as society evolves ethical concerns also evolve. This philosophical acceptance of indeterminacy and change complements the ecological principles of uncertainty and change, discussed in greater detail below.

Pragmatists also recognize that communities may hold many conflicting values. Pragmatic methodology is designed to resolve conflicts in the way that best serves the community.¹³ Conflicts over environmental policy and law are born of the conflicting values held by those who seek to reduce environmental risks as opposed to those whose primary concern is economic efficiency.¹⁴ Thus, pragmatism can serve as a useful tool to reconcile the inevitable conflicts, which environmental policy must address.¹⁵

stems from its practical ability to benefit the community and to solve society's problems. SIDNEY A. SHAPIRO & ROBERT L. GLICKSMAN, *RISK REGULATION AT RISK: RESTORING A PRAGMATIC APPROACH* 15 (2003). One of the most influential philosophical pragmatists of the twentieth century, John Dewey, stressed the idea that knowledge is better gleaned from experience than abstract reasoning. *See generally* JOHN DEWEY, *EXPERIENCE AND NATURE* (Eugene Freeman ed., 2d. ed. 1971). Other traditional philosophical pragmatists include William James, Charles Pierce, Josiah Royce, and George Herbert Mead. Mintz, *supra* note 10, at 1-2. *See generally* THE AMERICAN PRAGMATISTS (Milton Konvitz & Gail Kennedy eds., 1960). In keeping with this practical measure of the value of ideas, pragmatists believe that ideas are valuable and true when they are accepted by what is referred to as a "critical community of inquiry." SHAPIRO & GLICKSMAN, *supra* at 16. In other words, only after a community has analyzed, deliberated, and vetted an idea and found it to be beneficial in solving a problem does that idea become valuable to the community. Further, the value of such ideas changes as the community changes.

12. Early twentieth-century philosophical pragmatists were fascinated by the scientific developments of the time. Darwin's theory of evolution led these early pragmatists to view human thought in evolutionary terms, constantly evolving as a "problem-solving capacity, oriented towards survival." SHAPIRO & GLICKSMAN, *supra* note 11, at 15 (quoting Thomas C. Grey, *Holmes and Legal Pragmatism*, 41 STAN. L. REV. 787, 796 (1989)). Decisions may change as new experience or experimentation points to better ways to meet such societal needs.

13. SHAPIRO & GLICKSMAN, *supra* note 11, at 20.

14. *See* Ruhl, *supra* note 11, at 523. Ruhl states:

Since almost immediately after its statutory big bang in the early 1970s, [footnote omitted] two extreme and opposing philosophies—one devoted to protecting the economy and the other to protecting the environment—have waged a war of annihilation that has left in its wake a mish-mash of laws, regulations, judicial opinions, and countless administrative decisions and policies that we today call environmental law.

Id.

15. SHAPIRO & GLICKSMAN, *supra* note 11, at 21, 52.

B. Farber's "Eco-pragmatism"

Professor Daniel Farber's 1999 book, *Ecopragmatism*,¹⁶ paved the way for the recent flurry of scholarship attempting to use pragmatism as a guiding principle for environmental regulation.¹⁷ Many environmental

16. DANIEL A. FARBER, *ECO-PRAGMATISM: MAKING SENSIBLE ENVIRONMENTAL DECISIONS IN AN UNCERTAIN WORLD* 35 (1999). Eco-pragmatism draws on the wider movement in legal scholarship known as legal pragmatism. *Id.* at 9. Legal pragmatism holds that decisions should be made by drawing on many sources. In the environmental setting, these sources include scientific understanding and normative judgments as well as economic considerations. *Id.* at 10. Professor Farber's book starts from the premise that the legitimacy of environmental values is a given in the United States. The harder question, he maintains, is what priority to assign to those environmental values and how to weigh them against other values such as economic needs. A basic tenet of Farber's approach is that for environmental law to be socially sustainable, it must be pluralist, flexible, and not overly draconian. In other words, to be socially sustainable, environmental protection must proceed as "a marathon, not a sprint." *Id.* at 13.

17. Although Farber was the first to develop the field of eco-pragmatism, the field of environmental pragmatism had been in existence since the late 1980s. *See, e.g.*, ENVIRONMENTAL PRAGMATISM (Andrew Light & Eric Katz eds., 1996). Environmental pragmatism developed as a way to apply philosophical pragmatism to address environmental concerns. Mintz, *supra* note 10, at 6. Although eco-pragmatism certainly derives much from environmental pragmatism, Farber's eco-pragmatism attempts to apply pragmatism to environmental laws and policies in particular. *Id.* at 14. Farber's book has been reviewed by a number of prominent environmental law scholars, generating varied reactions. While some scholars have expressed reservations over Farber's ideas, others have generally reacted positively to the overall thrust of the book, if not to the specifics. *See* Lisa Heinzerling, *Pragmatists and Environmentalists*, 113 HARV. L. REV. 1421 (2000) (book review) (criticizing Farber's approach as too modest and not sufficiently transformative); Christopher H. Schroeder, *Clear Consensus, Ambiguous Commitment*, 98 MICH. L. REV. 1876, 1880 (2000) (book review) (describing Farber's book as containing "valuable discussion[] of [environmental] problems [and] offering important insights into dealing with them"); Christopher H. Schroeder, *Prophets, Priests and Pragmatists*, 97 MINN. L. REV. 1065, 1097 (2003) (stating that "[p]ragmatism's essential appeal is thus that it is the best bet for putting environmental policy on a glide path to the goals that the [environmental] prophets wants, and indeed the steepest glide path feasible"); J. B. Ruhl, *supra* note 11, at 545 (generally providing a very favorable review of eco-pragmatism but expressing disappointment for its lack of passion). *See also* Paul Boudreax, *Environmental Costs, Benefits, and Values: A Review of Daniel A. Farber's Eco-Pragmatism*, 13 TUL. ENVTL. L.J. 125, 167 (1999) (book review) (stating that while Farber's eco-pragmatism provides a good starting point for broad-based thinking about problems in environmental law, it fails in its specific recommendations on how to apply pragmatism to environmental policy). Despite any perceived shortcomings in the book, it cannot be denied that Farber's ideas have been provocative and have led the way for a flurry of scholarly analysis of how pragmatic ideas could be applied to environmental law. *See, e.g.*, ENVTL. LAW INST., *THE JURISDYNAMICS OF ENVIRONMENTAL PROTECTION: CHANGE AND THE PRAGMATIC VOICE IN ENVIRONMENTAL LAW* (Jim Chen ed., 2003) (compiling writing on eco-pragmatism and related concepts including works by Jim Chen, Daniel Farber, J.B. Ruhl, Dan Tarlock, Christine Klein, Jonathan Alder, Christopher Schroeder, Douglas Kysar, James Salzman, Richard Lazarus, Lisa Heinzerling, Holly Doremus, and Alyson Flournoy, among others); SHAPIRO & GLICKSMAN, *supra* note 11, at 46 (arguing that pragmatism provides the rationale for regulating based on risk, which has been missing from debates on environmental policy); Jamie A. Grodsky, *The Paradox of (Eco)pragmatism*, 97 MINN. L. REV. 1037 (2003) (arguing that eco-pragmatism's middle-ground compromise and flexibility must be tempered to include clear rules that can be adjusted over time). Farber himself has continued to weigh-in on the subject. *See* Daniel A. Farber, *Building*

law scholars seemingly have been yearning for a theoretical framework to guide the development of an environmental middle ground between the two extremes of absolute risk-based regulation, which does not adequately take costs into account, and cost/benefit analysis,¹⁸ which, as described in section III.C.2.a below, has many shortcomings in the area of environmental protection. Eco-pragmatism, for many, provides the rationale for moving beyond the goal of economic efficiency to focus instead on making all feasible reductions in human and environmental risks.¹⁹ Nevertheless, despite the recent wealth of scholarship on eco-pragmatism, few attempts have been made to apply the approach in any systematic way to an existing environmental regulatory scheme.²⁰

Farber outlines the four most difficult questions to be answered in developing an environmental regulatory system: 1) how to determine how much an environmental rule is worth, tapping into the long-standing debate over risk-based approaches to environmental protection versus cost/benefit approaches; 2) what is the appropriate baseline for environmental decision-making, raising the issue of whether there is some inherent value in environmental protection such that any error should be on the side of protection; 3) how to determine how much to spend today to achieve a benefit that may not accrue for decades, raising the issue of the appropriate discount rate to use in environmental valuation;²¹ and 4) how to know when to proceed in the face of imperfect

Bridges over Troubled Waters: Eco-pragmatism and the Environmental Prospect, 97 MINN. L. REV. 851 (2003).

18. FARBER, *supra* note 16, at 35.

19. See generally SHAPIRO & GLICKSMAN, *supra* note 11 (providing much of the justification for a pragmatic approach to environmental law that Farber's book was criticized for lacking).

20. One of the few attempts to apply an eco-pragmatic approach to environmental law is J.B. Ruhl's article, *Is the Endangered Species Act Eco-pragmatic?*, 87 MINN. L. REV. 885 (2003). Ruhl identifies what he refers to as the five pillars of eco-pragmatism: 1) drawing an environmental baseline; 2) institutionalizing the precautionary principle; 3) integrating impact assessment; 4) the importance of empiricism; and 5) adaptive management. *Id.* at 888-89. After testing the Endangered Species Act (ESA) against these five pillars, Ruhl concludes that "all the eco-pragmatism pieces are there." *Id.* at 941. For example, Ruhl identifies the ESA's jeopardy prohibition as providing an environmental baseline, the ESA's take prohibition as an institutionalization of the precautionary principle, the ESA's incidental take procedure as utilizing impact assessment, the ESA's best available evidence standard as employing empiricism, and the recent implementation of habitat conservation planning under the ESA as incorporating adaptive management techniques. *Id.*

21. There is much debate over the appropriate discount rates that should be used in environmental cost/benefit analyses or other forms of balancing such as constrained balancing. Cost/benefit and other balancing analyses are influenced dramatically by the choice of discount rate. The higher the discount rate, the more likely that the analysis will conclude that the resource-using or resource-polluting activity is efficient. Whereas a low discount rate assigns greater value to future benefits and, as a result, is more likely to conclude that the benefits of regulation outweigh the costs. Eco-pragmatism argues in favor of the use of a low discount rate. FARBER, *supra* note 16, at 89-90, 133. Although a detailed discussion of the appropriate discount rate to use in environmental decision-making is beyond the scope of this Article, there

information, raising the related issues of whether precautionary approaches should be used in environmental decision-making and how to incorporate adaptive management ideas into environmental laws. Farber answers these questions within a pragmatic framework, finding that the pragmatic answers to the four questions are: 1) economics should be utilized in a hybrid approach bridging the gap between pure risk-based and cost/benefit approaches; 2) environmental law should presumptively favor the environment—an environmental baseline; 3) a low discount rate should be employed in the valuation of long-term environmental benefits; and 4) flexible, adaptive approaches are necessary to allow regulation to adapt as new information becomes available. Despite the strengths of eco-pragmatism, as described more fully below, the theory is strengthened considerably by more consciously incorporating principles of ecological science.

C. Strengthening the Eco in Eco-pragmatism

1. Background Discussion

Professor J.B. Ruhl's review of Farber's work described eco-pragmatism as a marriage of two themes: the "eco" theme, a scientifically-based theme focusing on the dynamic character of natural systems, and the "pragmatic" theme which draws on philosophical pragmatism.²² As Ruhl describes it, the fusion of the dynamic nature of ecological systems and environmental pragmatism form eco-pragmatism, "a new approach to making environmental decisions in an uncertain world."²³ Despite his general affinity for eco-pragmatism, Ruhl expresses disappointment that Farber's work fails to address, except in a very

are sound reasons for adopting a low discount rate. For instance, the consequences of environmental decisions extend deep into the future. The further out in time we attempt to predict environmental consequences, the more the accuracy of such projections diminishes. FARBER, *supra* note 16, at 133. Using a low discount rate is a way to take the long view. Ruhl, *supra* note 11, at 539. A low discount rate does not devalue long-term environmental benefits. Moreover, our limited understanding of environmental issues lends support to more cautious predictions of future benefits. As hard as it is to put a dollar value on today's environmental resources, it is almost impossible to put a dollar value on what they will be worth in twenty or thirty years. Our limited understanding of natural systems suggests we may not even begin to understand the value that natural systems may hold in the future. High discount rates can make significant future benefits look insignificant today. FARBER, *supra* note 16, at 151. Perhaps the most compelling rationale for employing low discount rates is what is known as "inter-generational equity." There is so much that is not known about the value of natural systems today that it would be reckless to fritter away resources today which may later be found to have great value (utilitarian or otherwise) to future generations. *Id.* at 151-52. Thus, we should be prudent in how much we discount the environmental benefits that natural systems hold for future generations.

22. J.B. Ruhl, *supra* note 11, at 523-24.

23. *Id.* at 524.

cursory fashion, the “eco” partner in the eco-pragmatism marriage.²⁴ As Ruhl points out, the past thirty years have evidenced dramatic changes in the study of natural systems.²⁵ During this period, the field of ecology has come into its own, and the new fields of conservation biology and ecosystem management have been born. Unprecedented developments in our understanding of natural systems have also occurred. Our once-accepted simplistic view of the “balance of nature” has been challenged, and we now are beginning to see nature as being considerably more complex and dynamic than we once believed.²⁶ Accordingly, environmental decision-makers must accept and incorporate into their decision-making the continually changing nature of ecosystems.²⁷

A close study of ecological principles reveals that they are consistent in many ways with eco-pragmatism and, in fact, may serve to bolster and further develop Farber’s ideas. A good starting point for an attempt to understand the complexity, uncertainty, and changing nature of natural systems is an understanding of the numerous fields of inquiry and terminology used to describe these systems. Ecology is the science of the interactions of living organisms with each other and their physical environments.²⁸ Ecology has existed for many decades; however, only in the last twenty years or so has ecology advanced to a preliminary understanding of the importance of biodiversity to natural systems. Biodiversity is defined as “the richness, abundance, and variability of plant and animal species and communities and the ecological processes that link them with one another and with soil, air and water.”²⁹ The measure of biodiversity is not merely an accounting of the number of species present in an area; it also has a functional component.³⁰ Accordingly, a focus on preserving individual species from extinction is not sufficient to preserve biodiversity unless ecological processes are also maintained.³¹ Thus, an overriding goal of biodiversity protection is to maintain all of the elements of biodiversity, including both structural diversity (i.e., forms and levels of organization) and functional biodiversity (i.e., ecological and evolutionary functions).³²

24. *Id.*

25. *Id.*

26. See generally DANIEL B. BOTKIN, DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE TWENTY-FIRST CENTURY (1990) and Judy L. Meyer, *The Dance of Nature: New Concepts in Ecology*, 69 CHI.-KENT L. REV. 875 (1994).

27. Ruhl, *supra* note 11, at 528.

28. RICHARD O. BROOKS ET AL., LAW AND ECOLOGY: THE RISE OF THE ECOSYSTEM REGIME 7 (2002).

29. MALCOM L. HUNTER, JR., FUNDAMENTALS OF CONSERVATION BIOLOGY 20-21 (1996) (providing the 1993 Wildlife Society definition of biodiversity) (emphasis omitted).

30. *Id.* at 21.

31. See *id.*

32. *Id.*

Conservation biology, a relatively new applied scientific discipline, addresses the complex relationship between human activities and the protection of ecological systems. Professor Michael Soulé, one of the founders of conservation biology, defined it as "a new stage in the application of science to conservation problems, [which] addresses the biology of species, communities, and ecosystems that are perturbed, either directly or indirectly, by human activities or other agents. Its goal is to provide principles and tools for preserving biological diversity."³³

Although conservation biology is still a relatively young and ill-defined science, certain postulates have been proposed. Professor Soule divides these postulates into two categories: 1) functional postulates; and 2) ethical or normative postulates.³⁴ He describes the functional postulates as a set of fundamental rules gleaned from basic sciences, including ecology, that are geared toward the maintenance of both the form and function of natural biological systems.³⁵ Perhaps most pertinent for legal analysis are Soule's ethical or normative postulates which can be utilized as a fundamental ecological baseline for an environmental management or regulatory system: 1) biological diversity is good; and 2) ecological complexity is good.³⁶

33. Michael E. Soulé, *What is Conservation Biology?*, in ENVIRONMENTAL POLICY AND BIODIVERSITY 35 (R. Edward Grumbine ed., 1994). Conservation biology has also been described as a "regulatory science that seeks to develop scientific standards that can be applied to regulatory criteria and then to develop the management strategies to meet those standards." A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOY. L.A. L. REV. 1121, 1130 (1994). Conservation biology arose in the late 1970s and early 1980s in reaction to the unprecedented worldwide extinction crisis that many biologists believe is occurring due to the activities of humans. HUNTER, *supra* note 29, at 15. Accordingly, conservation biology is an applied "crisis" discipline that is to biology what surgery is to physiology. Soulé, *supra* at 35. The driving force behind conservation biology is the belief that, without serious efforts to reverse the trend of mass extinctions, millions of species may be at risk of extinction. *Id.* at 48. The loss of species may have devastating consequences for humans, as well as for the planet as a whole. Due to the permanence of extinction, rare species are often the focus of conservation biology. EDWARD O. WILSON, THE DIVERSITY OF LIFE 228 (1992). The seminal works on conservation biology include: CONSERVATION BIOLOGY: AN EVOLUTIONARY-ECOLOGICAL PERSPECTIVE (Michael E. Soulé & Bruce A. Wilcox eds., 1980) and CONSERVATION BIOLOGY: RESEARCH PRIORITIES FOR THE NEXT DECADE (Michael E. Soulé & Gordon H. Orians eds., 2001).

34. Soulé, *What is Conservation Biology?*, *supra* note 33, at 38-45.

35. Soulé's functional postulates include: 1) many species are products of co-evolutionary processes—i.e., in most communities, species make up a significant part of other species' environment; 2) species are interdependent—i.e., mutualistic relationships exist between many species, thus, there are always uncertainties about the impact that the extinction of one species will have on another species; 3) many species are highly specialized—i.e., the majority of animal species depend on a particular host, thus, if such a host becomes extinct, many other species may be adversely affected; 4) extinction of "keystone species" can have long-term consequences; 5) introduction of generalist species may reduce diversity; and 6) many ecological processes have thresholds below which they become discontinuous, chaotic, or suspended. *Id.* at 38-42.

36. *Id.* at 42-44.

Most law and policy initiatives concerning conservation biology and biodiversity protection have focused on deciding which lands to preserve based on their diversity, uniqueness, connectivity to other lands, or other factors. While the importance of preserving significant lands cannot be overstated, such preservation would be in vain if contamination of air, water, and land, both inside and outside of preserved areas, is not addressed. Environmental pollution is the most subtle form of ecological degradation, and, despite the banning of numerous pesticides over the past thirty years, pesticidal pollution remains one the most serious forms of ecological degradation.³⁷ No matter how strictly protected from human activity, an area will never be truly protected if contaminants such as pesticides enter through the water or air or if species that use the protected area are exposed to harmful contaminants upon leaving.³⁸

Although some legal scholars have analyzed environmental law in a general sense from a conservation biology perspective,³⁹ to date the attempts made to evaluate specific management or regulatory schemes using such an approach have focused primarily on natural resources management or the Endangered Species Act,⁴⁰ rather than pesticide law or pollution control law.

Another important ecological concept is that of ecosystem management. Ecosystem management is a tool to carry out the principles of conservation biology. Although environmental literature is rife with varying descriptions and definitions of ecosystem management, a general consensus appears to have arisen: the overriding goal of ecosystem management is to protect long-term ecological integrity.⁴¹ Ecological integrity is defined as the total native diversity of species, populations,

37. RICHARD B. PRIMACK, *ESSENTIALS OF CONSERVATION BIOLOGY* 145–46 (1993).

38. Although the primary threat to species and ecosystem diversity is habitat destruction, even when habitats are preserved, many populations have been reduced to such an extent that they are extremely vulnerable to other environmental stresses such as hazardous pollutants. Moreover, the vast majority of land in the United States is privately owned, and it would be naive to believe that enough property could be put into perpetual preservation to achieve true ecological integrity on a large scale. Thus, it is necessary to complement land preservation programs with effective regulatory programs that protect widespread ecological integrity while allowing human activities to proceed.

39. See, e.g., Walter Kuhlmann, *Making the Law More Ecocentric: Responding to Leopold and Conservation Biology*, 7 DUKE ENVTL. L. & POL'Y F. 133 (1996); Robert B. Keiter, *Conservation Biology and the Law: Assessing the Challenges Ahead*, 69 CHI.-KENT L. REV. 911 (1994); Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 CHI.-KENT L. REV. 847 (1994); and William H. Rodgers, *Adaptation of Environmental Law to the Ecologists' Discovery of Disequilibria*, 69 CHI.-KENT L. REV. 887 (1994).

40. See, e.g., Holly Doremus, *Adaptive Management, the Endangered Species Act, and the Institutional Challenges of "New Age" Environmental Protection*, 41 WASHBURN L.J. 50 (2001).

41. See R. EDWARD GRUMBINE, *Introduction to ENVIRONMENTAL POLICY AND BIODIVERSITY* 8–9 (R. Edward Grumbine ed., 1994).

and ecosystems, and the ecological patterns and processes that maintain such diversity.⁴²

Interestingly, at the same time that ecological science, conservation biology, and ecosystem management were developing in the scientific world, parallel ideas, including many of those that form the basis of eco-pragmatism, were developing in the legal arena. While not couched in terms of conservation biology, eco-pragmatism starts to look startlingly like conservation biology when boiled down to its essentials. Parallels between the cross-disciplinary applied science of conservation biology and the legal theoretical construct of eco-pragmatism exist in a number of respects. For instance, both approaches articulate the need to start from an ecological baseline. Moreover, both disciplines recognize the importance of adaptive management approaches to address the changing nature of both biological systems and our ability to comprehend them. Finally, although both systems argue in favor of accounting for costs in environmental decision-making, neither approach elevates costs to the level of being the deciding factor.⁴³

Perhaps most significantly, both disciplines acknowledge that although we can never completely prevent all human disturbances, we do not necessarily need to. Human disturbances similar in characteristic, magnitude, and duration to natural disturbances are not as likely to pose significant risks to species or ecosystems as are human disturbances that are substantially different in characteristic, magnitude, or duration from natural disturbances.⁴⁴ Individual species, as well as entire ecosystems, have evolved to be resistant and resilient to the types and magnitudes of natural disturbance that they would normally experience in nature.

2. *The Role of Economics In Eco-Pragmatism*

Professor Daniel Farber's *Eco-pragmatism* analyzes from a pragmatic standpoint what role economic considerations should play in environmental decision-making. Farber offers a sound rationale for reaching the conclusion that a hybrid, or feasibility, approach is the most

42. See *id.* at 8 (citing B. Norton, *A New Paradigm for Environmental Management* 23-41 in *ECOSYSTEM HEALTH* (R. Costanza et al. eds., 1992)).

43. Leading conservation biologist Professor Reed Noss has described an approach to applying principles of conservation biology to environmental law. See Reed F. Noss, *Some Principles of Conservation Biology, As They Apply to Environmental Law*, 69 CHI.-KENT L. REV. 893, 897-900 (1994). Some of the guiding principles of conservation biology can be summarized as follows: 1) ecosystems are more complex than science can understand; 2) the less data or more uncertainty involved, the more conservative environmental decision-making should be; 3) ecosystems are not static, but instead are constantly in a state of disequilibria; 4) conservation biology is by its very nature value-laden and goal-driven; and 5) environmental management decisions must be concerned with ecological processes at multiple levels of biological organization. See *id.* at 898-900.

44. Meyer, *supra* note 26, at 882-83.

pragmatic. Significantly, Farber's conclusions are further supported when ecological principles are incorporated into the eco-pragmatic analysis.

a. A Rejection of Pure Risk-Based and Cost/Benefit Standards

The past twenty years of environmental law scholarship is characterized by a struggle between two opposite extremes—those who believe environmental values are paramount and those who believe economic interests are paramount.⁴⁵ Environmental regulation in the United States is frequently criticized as unrealistic because it is based on protecting the public or environment from risks without considering the costs associated with such protection.⁴⁶ Of course, an attempt to eliminate all environmental risks at all costs would be absurd.⁴⁷ Opponents of pure risk-based approaches contend that environmental regulations seek to attain zero risk regardless of the costs of attaining such a goal. For the most part, these criticisms are unfounded.⁴⁸ Despite the outcry of the opponents of risk-based regulation, the vast majority of federal

45. FARBER, *supra* note 16, at 35.

46. As Supreme Court Justice Breyer and Professor Cass Sunstein have described, some environmental risk reduction requires expenditures of money that go well beyond the bounds of common sense. See STEPHEN BREYER, *BREAKING THE VICIOUS CIRCLE: TOWARD EFFECTIVE RISK REGULATION* 14 (1993) and Cass R. Sunstein, *Health-Health Tradeoffs*, 63 U. CHI. L. REV. 1533 (1996).

47. FARBER, *supra* note 16, at 3.

48. Although examples of environmental excesses certainly can be found, many if not most of such criticisms have been demonstrated to be without merit. SHAPIRO & GLICKSMAN *supra* note 161, at 22. In one of the most comprehensive analyses of the costs of environmental regulation to date, Lisa Heinzerling demonstrated that many of the oft-cited examples of the excessive costs of environmental regulations are not accurate. Lisa Heinzerling, *Regulatory Costs of Mythic Proportions*, 107 YALE L.J. 1981 (1998). Heinzerling has shown that many of the examples used by cost/benefit proponents are either exaggerations or are examples of regulations that were considered but never adopted for a variety of reasons. *Id.* In this article, Heinzerling scrutinizes the "Morrall table," developed in 1986 by John Morrall, an economist at the Office of Management and Budget. *Id.* at 1983, 1987–89. The table includes information on the costs of various risk-reducing regulations per life saved. *Id.* at 1987–88. The numbers from this table have been relied on extensively by scholars, environmental policy-makers, and politicians to support arguments that environmental regulations are not cost-effective and that taxpayer money could be better spent elsewhere. See *id.* at 1983. Heinzerling demonstrates that the estimates of the costs of environmental regulations developed by Morrall, and widely relied upon by proponents of cost/benefit analysis, are seriously flawed. *Id.* at 1984. First, Heinzerling shows how Morrall included a large number of regulations that were never adopted by the regulatory agency. *Id.* at 1999–2014. Heinzerling demonstrates that the alleged highest-cost environmental regulations on Morrall's table have never taken effect. *Id.* at 1983, 1999–2014. In fact, some of these proposed rules were withdrawn by the agency specifically because of the high costs associated with them. *Id.* at 2000–10. Moreover, Heinzerling shows how Morrall's use of cost estimates skew the results by being up to 1000 times higher than the agency estimates. *Id.* at 1983, 1991–93. Further, Heinzerling shows how Morrall's estimates are misleading in that he used a high (10 percent) discount rate. *Id.* at 2018. Heinzerling's analysis shows that by using the agency's cost estimates and a lower discount rate, the cost per life saved for most of these regulations falls well within the accepted range. *Id.* at 2041.

environmental laws are not purely risk-based and few, if any, are zero-risk statutes.⁴⁹ Instead, most environmental laws allow or require the consideration of other factors such as the costs of regulation or the economic feasibility of regulation. Even where zero-risk or absolutist risk-based environmental laws have been tried, frequently the recognition of the illogical outcomes of these approaches have led to either interpreting the laws to account for other factors or amending the laws imposing these strict risk-based requirements.⁵⁰ Because of the illogical

49. This is for good reason. It is impossible to eliminate all risk. First, as risks are reduced to lower levels, the costs of eliminating remaining risks may be excessively high. Second, in many cases it is impossible to attain zero risk because technology does not exist to measure very small amounts of pollutants or very small environmental disruptions that may cause risk. Third, it is not uncommon for risk reduction measures that are employed to address one risk to cause some other unintended risk. Finally, risk is inherent in nature. *FARBER, supra* note 16, at 72–74.

50. Perhaps the most notable absolutist zero-risk-based law was the Delaney Clause of the Federal Food Drug and Cosmetic Act (FFDCA). 21 U.S.C. § 348 (1994). As one of the few environmental statutes to attempt to impose a zero-risk standard, the Delaney Clause was highly controversial. In fact, EPA attempted to interpret into the statute a *de minimis* exception, despite the absolutist language contained in the law. EPA's *de minimis* interpretation of the Delaney Clause was struck down by the Ninth Circuit in *Les v. Reilly*, 968 F.2d 985 (9th Cir. 1992). After many years of controversy, in 1996, Congress eliminated the zero-risk language in favor of the more flexible "safety" standard in the Food Quality Amendment Act, Pub. L. No. 104–170, 110 Stat. 1489 (codified at 7 U.S.C. §§ 136–136y and 21 U.S.C. §§ 301–381 (2000)). Prior to 1996, food additives in or on processed foods were regulated under section 409 of the FFDCA, whereas pesticide residues in or on raw agricultural commodities were regulated under section 408 of the FFDCA. Section 408 deemed any poisons or deleterious pesticide chemical that is not generally recognized as safe when added to a raw agricultural commodity to be unsafe unless a tolerance is established and the pesticide residue is within the tolerance limit. Section 408 authorized EPA to establish tolerances "to the extent necessary to protect public health" and mandated that in making such determination EPA give appropriate consideration to certain factors including the necessity for the production of an adequate, wholesome, and economical food supply. Thus, the standard for setting a tolerance under section 408 included economic considerations. The term "pesticide chemical" is defined as any substance which, alone, in chemical combination, or in formulation with one or more other substance is a pesticide within the meaning of FIFRA and which is used in the production, storage or transportation of raw agricultural commodities. 21 U.S.C. § 321(q) (2000). Generally Recognized as Safe (GRAS) is defined as generally recognized among experts qualified by scientific training and expertise to evaluate its safety as having been adequately shown through scientific principles (or for a substance in food prior to January 1958, through either scientific procedures or based on common use in food) to be safe under conditions of its intended use. 21 U.S.C. § 321(s) (2000). For processed foods, however, a completely different standard applied. Pursuant to the pre-1996 section 402 of the FFDCA, a food was deemed to be adulterated if it contained any food additive not authorized by a food additive regulation under section 409. The standard for setting a food additive regulation, however, was far different from the standard for a tolerance under section 408. Under section 409, to issue a food additive regulation, EPA would have to find that the use of the food additive under the conditions of use specified in the regulation would be "safe." Further, section 409 contained the Delaney Clause which provided that no food additive shall be deemed to be safe if it is found to induce cancer when ingested by man or animals, or if tests show it induces cancer in man or animals. Accordingly, section 409 contained a strict "safety" standard and a complete prohibition of any carcinogenic food additive in any amount. After many years of controversy over the disparity and unsuccessful attempts by EPA to interpret the Delaney Clause as imposing a *de minimis* risk standard rather than a zero risk standard, the 1996 FQPA amendments to FFDCA eliminated the absolutist Delaney Clause.

outcomes of attempting to remove all risk and the diminishing returns when trying to eliminate every last trace of risk, zero-risk is not a reasonable goal. Even a pure risk-based standard that allows for a risk above zero may be unreasonable if the costs of reaching such a level of risk reduction are not feasible. Thus, eco-pragmatism rejects pure risk-based approaches.

At the opposite end of the spectrum from the pure risk-based approaches to environmental regulation are those approaches that elevate economic efficiency above all other considerations. Cost/benefit analyses involve balancing the "social benefit" of a regulation against the cost to society to comply with the regulation.⁵¹ The argument in favor of economic efficiency is that limited resources should be spent where they will do the most good. Cost/benefit standards are based on the premise that maximum economic efficiency is the goal of any regulatory system.⁵² The cost/benefit analysis measure of value is the consumer's willingness to pay for goods or services.⁵³ The concept of willingness-to-pay does not translate well to ecological values.⁵⁴ Moreover, relying on willingness-to-

Further, the 1996 Act eliminated the prior standards in both section 408 and section 409 and substituted a standard of "safety" in both sections. Accordingly, under the current law tolerances must be established for pesticide residues in food, whether in raw agricultural commodities or processed foods, at a level that is considered "safe." Safe is defined to mean there is a reasonable certainty that no harm will result from aggregate exposure to the pesticide chemical residue. This "reasonable certainty standard," while still a risk-based standard, replaces the zero-risk Delaney Clause with a negligible risk standard. It should be noted that prior to 1970, the Food and Drug Administration regulated food additives as well as pesticide residues in food under the FFDCA. Under the Reorganization Act of 1970, authority for the regulation of pesticides under both FIFRA and FFDCA was transferred to the newly formed Environmental Protection Agency. Reorganization Plan No. 3, 84 § 2086 (1970). Since 1970, EPA has regulated pesticide residues in or on raw agricultural commodities under section 408 of the FFDCA and pesticide residues in or on processed foods as food additives under section 409 of the FFDCA.

51. For a general overview of cost/benefit analyses, see CASS R. SUNSTEIN, *THE COST-BENEFIT STATE: THE FUTURE OF REGULATORY PROTECTION* (2002).

52. This makes sense in the context of choosing between two technologies to achieve the same level of risk reduction. For example, if, all else equal, it would cost \$10 million to install an end-of-pipe technology that would reduce water pollutants and thereby save five lives, but it would cost only \$1 million to use alternative raw materials in the manufacturing process that would achieve the same risk reduction goal, no reasonable person would question the decision to utilize the more economically efficient risk reduction method. However, the real world is rarely so clear-cut and typically environmental decisions are not a choice between two equally effective risk reduction methods. More often they involve complex trade-offs in risk reduction, costs and normative values that are not easily monetized. Consequently, cost/benefit analyses reach far beyond the obvious and simple goal of achieving an environmental benefit for the lowest cost possible. See FARBER, *supra* note 16, at 7.

53. FARBER *supra* note 16, at 36. The willingness-to-pay standard is a key component of welfare economics. For a good general discussion of the Pareto Criteria, as well as other theories of economic efficiency, including Kaldor-Hicks efficiency, see generally Jules Coleman, *Efficiency, Utility, and Wealth Maximization*, in *FOUNDATIONS OF THE ECONOMIC APPROACH TO LAW* (Avery Wiener Katz ed., 1998).

54. It can be difficult to determine how much people would be willing to pay for a given ecological service or benefit. Although it may be a relatively easy task to determine how much

pay may skew cost/benefit analyses away from protecting environmental values because the concept embeds an assumption that industry has the right to utilize resources so that those wanting to protect those resources have to be willing to pay for such protection.⁵⁵

people are willing to pay for certain types of values, such as how much more people are willing to pay for a safe product versus an unsafe product, in the environmental arena many values that are sought to be protected by environmental laws are what is known as "non-use" values. These non-use values include "option value," how much people are willing to pay to leave open the option of receiving a benefit in the future. An example of option value is the value people are willing to pay to preserve tropical rainforests to preserve the option of obtaining plants with medicinal value in the future. Farber, *supra* note 16, at 48. Another type of non-use value is "existence value," how much people are willing to pay to protect something that they will never directly benefit from. An example of existence value is how much people are willing to pay to protect an endangered species even if they will never receive any direct benefit from that species and in fact may never even see that species. *Id.* These non-use values are much more difficult to monetize in a cost/benefit analysis than are other types of values that provide a more direct impact to the person who is willing to pay for them. *Id.* at 49. One way that economists attempt to monetize these values is through a survey technique called contingent valuation. Cass Sunstein has criticized this technique as unreliable because surveys asking people hypothetically how much they would pay to preserve a particular non-use value may be skewed by people answering in a way that makes them feel morally satisfied rather than stating their real valuation. *Id.* at 49 (citing CASS R. SUNSTEIN, *FREE MARKETS AND SOCIAL JUSTICE* 142-43 (1997)). On the other side of the debate critics argue that contingent valuation is not an appropriate way to value natural resources. John M. Heyde, *Is Contingent Valuation Worth the Trouble?*, 62 U. CHI. L. REV. 331 (1995).

55. The question then becomes one of how much are the environmentalists willing to pay to protect the resources. If instead, one assumes that environmentalists have the right to protect resources and that industry must pay environmentalists or the public if it wishes to utilize those resources, the question becomes one of how much are environmentalists or the public willing to accept to allow the resources to be used. The amount of money an environmentalist is willing to accept to allow a resource to be used is typically twice as high as the amount of money the same environmentalist is willing to pay to protect the resource. FARBER, *supra* note 16, at 100. Nevertheless, most cost/benefit analyses use willingness-to-pay. SHAPIRO & GLICKSMAN, *supra* note 11, at 57. This is but one example of how cost/benefit analyses are not value-neutral. The value-based assumptions that underlie the analyses can dramatically alter outcomes. *See also id.* at 56 (explaining that willingness-to-pay and willingness-to-accept are typically different due to the distribution of wealth in society). A person's wealth does not tend to limit willingness-to-accept in the same way it limits willingness-to-pay. As a result, willingness-to-pay tends to result in less regulation. *Id.* at 56.

An example of the difference between willingness-to-pay and willingness-to-accept provided in Farber's book is the example of whalers desiring to kill a pod of whales. If one assumes that the whalers have a right to kill the whales for their own economic benefit, the question becomes how much environmentalists are willing to pay to prevent the whalers from killing the whales. This willingness-to-pay then becomes the economic value of the whales. If instead, one assumes that the environmentalists have the legal right to protect the whales, the question becomes how much are the whalers willing to pay the environmentalists for the right to hunt the whales. Under this scenario, it is likely that the environmentalists will demand a much higher price from the whalers than they would be willing to pay in the first scenario. One explanation for this phenomenon is that by assuming the environmentalists have the right to protect the whales and the consequent right to sell the hunting rights to the whalers the environmentalists have been made wealthier and more powerful. Thus, demand increases resulting in a higher price to hunt the whales. Consequently, under the second scenario, whaling that may have been economically efficient under the first scenario may no longer be efficient. FARBER, *supra* note 16, at 99. Another explanation for the difference between willingness-to-pay and willingness-to-

Proponents of cost/benefit analysis believe that sound decision-making is based on market indicators whereas environmentalists believe that such decisions should be based on political indicators, a distinction Farber refers to as "willingness-to-pay" versus "willingness-to-vote."⁵⁶ This distinction has been described as follows: "social regulation expresses what we believe, what we are, what we stand for as a nation, not simply what we wish to buy as individuals."⁵⁷ Moreover, relying solely on consumer choices excludes the possibility of decision-making based on community analysis, deliberation, and vetting of ideas.⁵⁸ Critics of cost/benefit analysis focus on the distinction between private consumer choices and public choices based on public values.⁵⁹ In the pesticide

accept may be that people tend to be attached to the status quo and that change can only be purchased at a high price. *Id.* at 100.

56. FARBER, *supra* note 16, at 42.

57. *Id.* at 53 (quoting MARK SAGOFF, *THE ECONOMY OF THE EARTH: PHILOSOPHY, LAW AND THE ENVIRONMENT* 17 (1988)). Professor Cass Sunstein made this point eloquently when he explained human character as being more than simply the acts an individual chooses to do at any given point in time. *See id.* at 54–55.

58. *See* SHAPIRO & GLICKSMAN, *supra* note 11, at 60. For example, the fact that an individual drives an SUV that gets poor gas mileage does not necessarily imply that such person does not value clean air or energy efficiency. The individual may have purchased the SUV with the primary consideration of safety and space for the family and its gear. Nevertheless, the individual may value clean air and energy efficiency and may fully support the imposition of tougher fuel economy standards on SUVs. The phenomenon of individual economic preferences frequently conflicting with societal desires is well-illustrated by the following exercise that Professor Scott Barrett of the Paul H. Nitze School of Advanced International Studies at Johns Hopkins University uses in his classroom. Professor Barrett's exercise can be seen as a variant of the prisoner's dilemma to show how individuals may make different choices when acting in a mode of consumer/wealth acquirer versus in a mode of democratic citizen. Barrett first hands out two playing cards, one black and one red, to each student in his class. He then instructs the students that each player will receive five dollars for keeping a red card plus one dollar for every red card handed in by any other player. Thus, if there are twenty students playing and each player hands in her red card, each of the twenty students will receive twenty dollars. If none of the twenty players hands in her red card, each student will receive only five dollars. If six players hand in their red cards, the other fourteen students receive eleven dollars each but the six who handed in their cards only receive six dollars each. The incentive for each individual player to keep her red card is obvious. Accordingly, when Barrett's class has played this game, less than two-thirds of the players turn in their red cards. Barrett explains that this is what the economists call a public good. All players benefit, and no player can be excluded from receiving that benefit. When Barrett asks these same students to vote anonymously on whether to allow a government regulation that would confiscate all of the red cards, thereby resulting in the best possible outcome for all students (i.e., each student receives twenty dollars), invariably a majority votes in favor of the government regulation. Frances Cairncross reaches the following interpretation of this game: "in other words, left to themselves, individual players are selfish, but they yearn for some outside force to make everybody behave better and improve the outcome of the game for all the players." Frances Cairncross, *What Makes Environmental Treaties Work?* CONSERVATION IN PRACTICE, Spring 2004.

59. Nevertheless, economists do recognize a difference between private consumer choices and environmental benefits. Economists consider many environmental benefits to be a public good. Public goods may not be sufficiently provided solely through the marketplace because all members of the public benefit from the good and charging all members of the public may be difficult. The classic example of a public good in the environmental context is clean air. All

regulation arena, an economic argument could be made that consumers' purchases of food treated with chemical pesticides are conscious choices based on economic and other factors. While consumers may purchase such foods because they are generally significantly less expensive than foods grown without chemical inputs, to assume that this consumer choice means that consumers have consciously determined that the health and environmental risks of pesticides in food are outweighed by the increased cost of organically produced food is overly simplistic for numerous reasons.

First, consumers may not be fully informed of the environmental and health risks associated with pesticide use. The time and thought required to sort out technical risk assessment information may be more than the average consumer can, or desires to, commit.⁶⁰ Moreover, as described at length in this Article, many of the risks of pesticides use are not well understood, even by the experts. Thus, it would be unreasonable to assume that consumers are able to make decisions on preliminary or confusing data that experts are having difficulty grappling with. Second, the price of food treated with pesticides does not reflect the true cost of growing the food because of what economists refer to as negative externalities.⁶¹ For example, the price of food treated with pesticides does not reflect the price that society may have to pay later to clean up pesticide contaminated sites, the long-term social costs of losing insect pollinators, or the long-term social costs due to the development of pest resistance resulting from overuse of pesticides. Third, the price of the food is artificially low due to the combination of the externalities, such as human health and environmental costs that are not reflected in the price and the numerous government programs that encourage the use of chemical inputs in agriculture.⁶² Crop subsidies, crop protection

members of the public breathe air, and thus, private enterprise cannot charge the public for the air it breathes. Accordingly, private enterprise cannot profit by ensuring its operations result in clean air. In recent years, Professor Cass Sunstein has introduced a modified form of cost/benefit analysis, in which public values rather than private preferences govern environmental decision-making. See FARBER, *supra* note 16, at 95 (describing the proposal in CASS R. SUNSTEIN, *FREE MARKETS AND SOCIAL JUSTICE* 139 (1996) involving a two-stage decision-making process. A traditional quantitative cost/benefit analysis would constitute the first stage. The second stage would take into consideration other non-quantifiable values).

60. The welfare economics assumption that the market results in resources being allocated to their highest and best use assumes that all consumers in the market have full information on which to base their choices. FOUNDATION OF THE ECONOMIC APPROACH TO LAW 40-41 (Avery Wiener Katz ed., 1998). If consumers do not have access to such information, the market fails. *Id.*

61. *Id.*

62. For a detailed discussion of government policies that encourage pesticide use, see Kenneth A. Dahlbert, *Government Policies that Encourage Pesticide Use in the United States*, in *THE PESTICIDE QUESTION: ENVIRONMENT, ECONOMICS, AND ETHICS* 281 (David Pimentel & Hugh Lehman eds., 1993) (discussing a wide range of local, state, and federal programs including price supports, incomes supports, farm credit programs, crop insurance programs,

insurance, and other government programs provide economic incentives for using pesticides, and economic disincentives for growing crops without chemical pesticides result in artificially low food prices, which may result in consumers purchasing more food grown with pesticides than they would in a pure market.⁶³ Accordingly, in the agricultural pesticide arena, as well as many other arenas, a cost/benefit analysis that relies on market costs and benefits is unlikely to reflect consumers' true preferences. Moreover, this example makes clear that the assumptions upon which costs/benefit analyses are based, including perfect information, no externalities, and a truly free market, deviate so far from reality that a simplistic cost/benefit analysis, standing alone, is an unreliable guide.

One controversial issue in the cost/benefit debate is whether environmental values are significant only to the extent that they can be translated into economic terms.⁶⁴ Opponents of cost/benefit analysis maintain that economists "price everything and value nothing."⁶⁵ Cost/benefit analysts tend to limit their view of the benefits of environmental regulation to human lives saved or cancers averted.⁶⁶ The true benefits of environmental protection extend far beyond counting the numbers of lives saved. For example, because non-lethal human health effects, including subchronic neurological, behavioral, or reproductive effects are not well understood and are not easily quantified, they are rarely included in any meaningful way in cost/benefit analyses.⁶⁷ Moreover, as described in detail below, ecological systems are not well understood by science and the value of such systems is not readily

export policies, and tax policies). See also David Pearce & Robert Tinch, *The True Price of Pesticides*, in *BUGS IN THE SYSTEM: REDESIGNING THE PESTICIDE INDUSTRY FOR SUSTAINABLE AGRICULTURE* 50 (William Vorley & Dennis Kenney eds., 1998).

63. *Id.* For a good summary of agricultural price supports, see Robert L. Thompson, *Agricultural Price Supports*, in *CONCISE ENCYCLOPEDIA OF ECONOMICS*, available at <http://www.econlib.org/library/Enc/AgriculturalPriceSupports.html>.

64. FARBER, *supra* note 16, at 35.

65. See generally FRANK ACKERMAN & LISA HEINZERLING, *PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING* (2004). See also David Pearce & Dominic Moran, *The Economics of Biological Diversity Conservation*, in *CONSERVATION BIOLOGY FOR THE COMING DECADE* (Peggy L. Fiedler & Peter M. Kareiva eds., 2d ed. 1998).

66. FARBER, *supra* note 16, at 88. Cost/benefit analyses typically rely on the concept of "statistical lives" saved because, under most risk assessments, it is impossible to identify the actual person that would have died but for the environmental regulation. Typically people value a statistical life less than an actual life. This is illustrated by the lengths that people will go, and the money they are willing to spend, to save a child who falls into a well compared to how much society is willing to spend to save an anonymous statistical person. See, e.g., SHAPIRO & GLICKSMAN, *supra* note 11, at 64. In the ecological context, people go to great lengths to save a beached whale but are only willing to spend a significantly lesser amount to save the statistical dolphin from the shrimper's net. It is even harder to predict how much people will be willing to spend to protect a statistical ecological service.

67. FARBER, *supra* note 16, at 88.

quantified. Consequently, human disruptions to ecological systems are rarely part of cost/benefit analyses. Furthermore, ethical, religious, aesthetic, and other normative values of environmental protection are not typically included in cost/benefit analyses. Finally, even those components of the cost/benefit analysis that are more easily monetized, such as the cost of compliance with environmental regulations, are difficult to estimate. Frequently, regulatory agencies are asked to take industry at its word,⁶⁸ and often in retrospect, the true costs of compliance are not as high as the pessimistic estimates suggested by industry.⁶⁹

Another concern often raised by opponents of simplistic cost/benefit analyses is that even when measured benefits exceed measured costs, what is not considered is the social distribution of costs and benefits. In other words, if a disproportionate share of the costs are borne by segments of the population who do not share proportionally in the benefits, is there truly a balance of costs and benefits? Environmental risks tend to be disproportionately borne by vulnerable populations—frequently people of color, low income, and/or weak political power—who do not share the benefits gained by industrial pursuits.⁷⁰ The benefits of development and industry typically go to the advantaged segments of society who typically do not bear a great portion of the risks resulting from such activities. Environmental justice⁷¹ proponents point out that cost/benefit analyses and other market-based systems can lead to the creation of risk “hot spots,” where, overall, the cost/benefit analysis may weigh in favor of an activity going forward, but within a given segment of society, typically economically and politically disadvantaged populations, the cost/benefit analysis weighs in the opposite direction—i.e., hot spots of risk with very little benefit. Accordingly, proponents of environmental justice reject strict cost/benefit analyses.⁷²

A similar argument can be made with regard to ecological resources. Risk hot spots may emerge in situations where overall the cost/benefit analysis weighs in favor of allowing a pesticide to be used, but in a particular geographic area, or with a particular species or ecosystem, risk

68. *Id.* at 90.

69. *Id.* at 167–68.

70. See generally CLIFFORD RECHTSCHAFFEN & EILEEN GAUNA, ENVIRONMENTAL JUSTICE: LAW, POLICY AND REGULATION (2002).

71. Although a detailed consideration of environmental justice is beyond the scope of this Article, it is a compelling issue in environmental policy and it provides one example of how cost/benefit analysis does not adequately address ethical, moral or fairness issues that cannot be monetized. For an excellent discussion of how market-based approaches disproportionately impact vulnerable populations. See *id.* at 33–37.

72. Proponents of cost/benefit analysis counter this argument by pointing out that segments of society that are disadvantaged will not necessarily be better off under an inefficient system. However, environmental justice advocates do not argue in favor of inefficiency for inefficiency's sake, but rather they are willing to tolerate some level of economic inefficiency to accomplish other important societal goals such as fairness.

may be disproportionately high. This may occur with regard to sensitive species, including threatened or endangered species, or with ecosystems with low resistance and or low resilience. One example of such a risk hot spot is the global amphibian crisis in which pesticides are implicated.⁷³ Although the cost/benefit analysis for a particular pesticide may reflect that the benefits outweigh the costs overall, this does nothing to protect the highly sensitive and highly vulnerable amphibian populations that may be disproportionately impacted by that pesticide.⁷⁴

Finally, the values inherent in ecological integrity or biodiversity are particularly ill-suited to be reduced to a dollar value.⁷⁵ Of course, many ecological products and services have instrumental value. Many species in nature can be eaten, made into medications, made into clothing or shelter, burned for fuel, or otherwise used.⁷⁶ However, what is considerably more difficult to value are the aesthetic, inspirational, religious, or spiritual reasons that many people value ecosystems.⁷⁷ And perhaps even more challenging is attempting to reduce to dollars and cents the value that species have as members of ecosystems. For example, species in an ecosystem may serve important roles as producers, consumers, decomposers, competitors, dispersers, or pollinators.⁷⁸ Each of these roles provides value to other members of the ecosystem, including humans.⁷⁹ Another concern with the strict cost/benefit approach which argues in favor of a cautious approach to cost/benefit analysis is the

73. See Carlos Davidson et al., *Spatial Tests of the Pesticide Drift, Habitat Destruction, UV-B, and Climate-Change Hypotheses for California Amphibian Declines*, 16 CONSERVATION BIOLOGY 1588 (2002).

74. Moreover, the amendment of FIFRA by the 1996 Food Quality Protection Act to include a "safety" standard for human food consumption may have resulted in a shift of risk away from food consumers to occupational workers and ecological resources. For example, organophosphate pesticides degrade quickly into benign breakdown products in the environment and on agricultural food products. Thus, the FQPA standard of "safety" for human food consumers may favor the use of organophosphate pesticides over other pesticides that do not break down as quickly, and thus leave residue on foods. However, as described below, organophosphates are highly acutely toxic to humans, other mammals, and birds and have been implicated in thousands of bird deaths. Accordingly, relying more heavily on organophosphates to meet the FQPA standard while reducing risks to food consumers may result in significantly increased risk to vulnerable farm worker populations and to ecological resources. The risk to farmworkers for pesticide exposure is extremely high. Ivette Perfecto & Baldemar Velasquez, *Farmworkers: Among the Least Protected*, in Rechtshaffen & Gauna, *supra* note 70, at 67-68. Because the vast majority of farmworkers are ethnic minorities—primarily Latinos—these risks raise significant environmental justice concerns. *Id.*

75. See, e.g., Ruhl, *supra* note 11, at 543.

76. HUNTER, *supra* note 29, at 43.

77. *Id.* Noted zoologist E.O. Wilson has coined the term "biophilia" to describe the deep emotional and spiritual relationship that many people share with other living organisms and the related sense of awe that frequently accompanies experience with the natural world. See generally EDWARD O. WILSON, *BIOPHILIA: THE HUMAN BOND WITH OTHER SPECIES* (1984).

78. HUNTER, *supra* note 29, at 52.

79. *Id.*

lack of knowledge and uncertainty regarding biological systems.⁸⁰ Our current limited understanding of ecological systems and inadequate methodologies for monetizing values prevent cost/benefit analyses from being sufficiently precise to control environmental decision-making.⁸¹

In sum, although a strict cost/benefit approach offers a relatively straightforward quantitative approach to addressing risk, and although economic considerations cannot be ignored when determining whether a regulation is warranted, the approach has a number of shortcomings. First, current data and methodologies are not adequate for accurate and precise analyses. Second, in practice, cost/benefit analyses do not adequately address ecological values, community values, and other normative considerations because reducing such values to monetary terms is impossible. Finally, far from being value-neutral, cost/benefit analyses are laden with biases in favor of those who seek to use resources and away from those who seek to protect resources. Accordingly, eco-pragmatism rejects the notion that cost/benefit analyses should control environmental decision-making. Nevertheless, economic analyses are considered to be useful factors to inform environmental decision-makers.⁸² In other words, cost/benefit analysis should assist rather than control environmental decision-making.⁸³

b. The Eco-Pragmatic Response: Embracing Feasibility

In contrast to pure risk-based and strict cost/benefit approaches, eco-pragmatism attempts to grapple with the complexities and lack of understanding of species and ecosystem values. Eco-pragmatism also recognizes that, in the real world, public policy decision-making must occur within certain unavoidable constraints. Accordingly, one of the foundations of pragmatism is a rejection of comprehensive rationality in favor of bounded rationality.⁸⁴ In a perfect world with perfect scientific

80. For a discussion of the complexities and uncertainties of biological systems, see *infra* notes 129–72 and accompanying text.

81. FARBER, *supra* note 16, at 42. Farber estimated the costs and benefits of a number of environmental regulations from 1988 and determined that the costs ranged from 55 to 77 billion and the benefits ranged from 16 to 135 billion dollars. *Id.* at 167–68. Thus, he concludes, the return on every dollar spent ranged between 21 cents and \$2.27. *Id.* As Farber puts it “we were either losing 80 percent of our investment or are more than doubling our money and we don’t know which!” *Id.* at 168.

82. FARBER, *supra* note 16, at 9; see also SHAPIRO & GLICKSMAN, *supra* note 11, at 63.

83. See Ruhl, *supra* note 11, at 538.

84. Bounded rationality recognizes that institutions that make policy decisions do not have complete information or unlimited time so as to enable them to make some theoretically optimal choice in every case. SHAPIRO & GLICKSMAN, *supra* note 11, at 23. The reality is that all institutional decision-making is “bounded” by limited time, limited costs, and limited information. *Id.* If these bounds did not exist, arguably cost/benefit analysis would be able to provide optimal choices. Pragmatism does not ignore the existence of such bounds, but instead

data on ecological risks and perfect cost/benefit methodologies that adequately value all costs and benefits, a cost/benefit approach may be compelling. However, with the complexity pervasive in ecological systems, the dearth of good data, and the confused state of cost/benefit methodology, all coupled with the need to act now, the pragmatist must find another way. The pragmatist will look to what has worked best in the experience of environmental law to date, and what has worked best is, at least arguably, technology-based approaches.

All but the most staunch proponents of cost/benefit analysis seem to recognize that cost/benefit analysis involves so many assumptions, judgment calls, values, and unquantifiable factors, that viewing cost/benefit analysis as a clear-cut quantifiable test, where all one has to do is plug the numbers in and the "right" answer comes out, is overly simplistic.⁸⁵ Eco-pragmatic theory recognizes many ethical considerations go beyond mere economic efficiency and must be taken into account in making environmental decisions.⁸⁶

For all of the reasons discussed above, eco-pragmatism rejects pure risk-based approaches and cost/benefit analysis in favor of a hybrid approach based on the concept of feasibility.⁸⁷ Under the hybrid approach, environmental risks are reduced to the amount feasible and cost/benefit analysis is used to assist, rather than control, decision-making.⁸⁸ This type of approach has been described as doing "the best we can."⁸⁹ While the goal is environmental risk reduction, there is recognition that at some point the costs of further risk reduction become too high to justify. Pragmatic risk regulation attempts to reconcile conflicting values by using a "feasibility" standard. In other words, eco-pragmatism "[strives] to achieve the maximum level of protection consistent with reasonable costs."⁹⁰

Although there has been extensive academic debate over the appropriateness of utilizing cost/benefit analyses or pure risk-based approaches in environmental regulation, Congress has, for the most part, rejected both pure risk-based and cost/benefit standards. Most of the substantial environmental regulatory programs involve "hybrid" standard—i.e., risk-based standards that take economic considerations

accepts these constraints and recognizes that decision-making must take them into account and adapt as new information becomes available.

85. FARBER, *supra* note 16, at 94.

86. *Id.* at 9. As Shapiro and Glicksman have put it, we should be trying to do better than simply attempting to "achieve the 'optimal' level of injury, death and environmental degradation." SHAPIRO & GLICKSMAN, *supra* note 11, at 21–22, 50.

87. Farber defines feasibility as where costs are "not grossly disproportionate to the benefits to be achieved." FARBER, *supra* note 16, at 94.

88. *Id.* at 122–23.

89. SHAPIRO & GLICKSMAN, *supra* note 11, at 22, 50.

90. *Id.* at 147.

into account but do not require strict cost/benefit balancing. Professors Shapiro and Glicksman have surveyed existing environmental regulatory statutes to determine which contain cost/benefit standards, which contain feasibility standards, and which are pure risk-based. Their work demonstrates that the majority of existing statutes contain standards that require risk to be avoided to the extent feasible or to the extent that the best available technology can achieve. Accordingly, these statutes are referred to as technology-based statutes. The most common examples of environmental statutes that utilize technology-based standards include the Clean Water Act⁹¹ and the Clean Air Act.⁹² While these standards take costs into account, they are not purely cost/benefit balancing standards.

The most common use of feasibility approaches in environmental law is what Shapiro and Glicksman refer to as constrained balancing. This approach is where the legislature establishes a level of environmental protection to be achieved by identifying regulatory objectives based on some model technology.⁹³ In this way, costs are considered in choosing an appropriate technology as the model, but costs are not directly weighed against benefits to determine the overall worthiness of an approach or objective.⁹⁴ This approach is what is commonly referred to as "technology based"⁹⁵ standard setting and is also what Farber refers to as feasibility-

91. See, e.g., 33 U.S.C. § 1311(b) (2000) (setting forth technology-based standards for point sources of water pollution).

92. See, e.g., 42 U.S.C. § 7502(c)(1) (2000) (specifying that existing stationary sources of air pollution in nonattainment areas implement all "reasonably available control technology").

93. SHAPIRO & GLICKSMAN, *supra* note 11, at 37.

94. *Id.* at 37. Examples of this type of approach include: the Clean Air Act's requirement for non-attainment areas that existing stationary sources implement all "reasonably available control technology" as expeditiously as practicable, 42 U.S.C. § 7502(c)(1); and the Safe Drinking Water Act's requirement that EPA establish maximum contaminant levels as close as feasible to achieving the level at which no known or anticipated health effects will occur. 42 U.S.C. § 300g-1(b)(4) (2000).

95. Technology-based standards are credited with much of the pollution reduction that has occurred since the environmental movement of the 1960s and 1970s. See Wendy E. Wagner, *The Triumph of Technology-Based Standards*, 2000 U. ILL. L. REV. 83, 85 (2000). Technology-based standards are the dominant mode of controlling the amount of pollution released into the environment in the United States. *Id.* at 88. These standards are typically developed by EPA in response to a congressional mandate for EPA to establish pollution limitations based on some prescribed standard such as the "best available technology." *Id.* at 88-89. Once Congress has mandated the use of a particular technology-based standard, EPA will conduct a review of currently available technologies for specific industrial sectors and choose the technology that best fulfills the congressionally-prescribed standard. *Id.* at 89. Typically, the specific technology chosen is not required to be employed. Instead, EPA determines the level of pollution control that can be achieved using the chosen standard. *Id.* Industry is then free to utilize any technology it chooses that complies with the numerical standard. Accordingly, industry has an incentive to develop the most efficient technology to meet the numerical standard. One drawback to using feasibility as a standard is that feasibility will vary with the economic strength of the industry. FARBER, *supra* note 16, at 83. For example, a strong manufacturing sector may be able to install costly pollution control technology while it may be infeasible for a weak sector of the economy

based decision-making. Under constrained balancing or feasibility approaches, risk reduction is sought to the point that additional reduction would result in extraordinary or disproportionate costs.⁹⁶

Although eco-pragmatism rejects pure strict cost/benefit balancing in favor of feasibility, it does recognize a range of approaches to considering costs that fall somewhere in between strict cost/benefit balancing and feasibility. For example, Shapiro and Glicksman describe a second category of balancing approaches as “open-ended balancing,” which they describe as a type of balancing whereby the legislature prescribes the factors that the agency must consider in making a decision but does not dictate the weight the agency must give to any particular factor.⁹⁷ Interestingly, Shapiro and Glicksman describe FIFRA as an open-ended balancing statute. While a facial reading of the statutory standard of “unreasonable effects” arguably reveals an open-ended balancing statute—whereby the agency is directed to consider a variety of risk and

to install the same technology. As a result, more economically successful industries are penalized for their success with stricter rule applications not imposed on less successful industries. *Id.* Many justifications have been expressed for using technology-based approaches to environmental protection. These approaches tend to better address non-economic values while still taking economic concerns into account. *See* SHAPIRO & GLICKSMAN, *supra* note 11, at 65. In addition, feasibility-based approaches recognize and account for bounded rationality *See id.* at 65. *See also supra* note 84 and accompanying text. A feasibility standard is pragmatic in the sense that it is consistent with widely-shared beliefs that environmental protection is important to society. SHAPIRO & GLICKSMAN, *supra* note 11, at 21. Feasibility approaches tend to prod industry toward environmental risk reduction until the point where additional protection becomes technologically or economically infeasible. *See, e.g.,* Ruhl, *supra* note 11, at 537. Moreover, some commentators maintain that technology-based standards are the best standards available because we do not have enough data to conduct true cost/benefit analyses for most environmental decisions. Adam Babich, *Too Much Science in Environmental Law*, 28 COLUM. J. ENVTL. L. 119 (2003). Finally, from a pragmatic perspective, technology-based approaches have worked well in the United States’ thirty year history of environmental law implementation. *See generally* Wagner, *supra* note 95. After conducting an extensive analysis of the role of technology-based standards in environmental law over the past thirty years, Professor Wendy Wagner concludes that technology-based approaches are one of the most important innovations in environmental law. *Id.* at 86. Wagner also lauds technology-based standards for being relatively easy to promulgate, readily enforceable, even-handed, adaptable, and efficient. *Id.* at 94–106 (finding that the rate of promulgation for technology-based standards outpaces other standards by three to ten times and describing how technology-based standards apply equally to all members of the regulated industry within a given category). Wagner explains that technology-based standards are easily enforceable because the numerical level of pollution allowed is clearly prescribed by rule. *Id.* at 100. Once emissions or discharges are sampled for pollutants, regulated entities either meet the numerical standard or they do not. *Id.* at 101–02. How they choose to meet the standard is irrelevant. For the same reason, technology-based standards are very predictable. *Id.* at 101. Regulated entities can readily determine what numerical standards they are expected to comply with by looking at the EPA rule for that industry category. *Id.* at 100. *See also* Thomas O. McGarity, *Media-Quality, Technology, and Cost-Benefit Balancing Strategies for Health and Environmental Regulation*, 46 LAW & CONTEMP. PROBS. 159, 199 n. 194 (1983).

96. SHAPIRO & GLICKSMAN, *supra* note 11, at 52.

97. *Id.* at 39.

benefit factors but has not been directed as to how to weigh such factors—in practice, EPA has interpreted and applied FIFRA as a cost/benefit balancing statute requiring a pesticide's benefits to outweigh its costs in order to be registered. EPA's interpretation has been articulated in agency orders⁹⁸ and upheld in many judicial decisions.⁹⁹ Thus, despite the significance of pesticides in the development of environmental law, FIFRA virtually stands alone in its cost/benefit approach to environmental protection.¹⁰⁰

3. *The Necessity of a Baseline*

One of the most significant concepts in Farber's work on eco-pragmatism is the idea of starting with an environmental baseline. Farber argues that some overarching principle is needed to guide decision-making and serve as a "tie-breaker" in the close cases.¹⁰¹ Farber posits that environmental risks should be reduced to the extent feasible and that the environmental baseline should be protected except in the case where the costs of protecting the baseline "are grossly disproportionate to the benefits."¹⁰² Eco-pragmatism's baseline starts with a presumption in favor of the environment.¹⁰³ However, Farber does not provide a comprehensive explanation of what the baseline should be. Ecological principles can be used to assist in developing an appropriate baseline.

Farber's primary justification for starting with an environmental baseline is the long-term commitment to environmental protection in the United States.¹⁰⁴ Farber posits that there is a general recognition that

98. Stevens Indus., Inc., 1 E.A.D. 9 (June 2, 1972) (Consolidated DDT Hearings).

99. *Env'tl. Def. Fund, Inc. v. Ruckelshaus*, 439 F.2d 584, 594 (D.C. Cir. 1971).

100. The only other major environmental statute employing a strict cost/benefit balancing approach is section 6 of the Toxic Substances Control Act, 15 U.S.C. § 2605 (2000), which has been rendered impotent by the Fifth Circuit decision in *Corrosion Proof Fittings v. EPA*, 947 F.2d 1201 (5th Cir. 1991) (holding that EPA did not have a reasonable basis to conclude that asbestos presents an unreasonable risk and that EPA failed to choose the least burdensome alternative to protect against such risk).

101. FARBER, *supra* note 16 at 93, 104.

102. *Id.* at 12.

103. Ruhl, *supra* note 11, at 537. As Farber explains, for any environmental regulatory scheme at least three possible baselines could be employed. FARBER, *supra* note 16, at 103. The first such baseline would be a neutral baseline in which there is neither a presumption in favor of the environmental nor one in favor of industrial/economic pursuits. *Id.* at 103. The second such baseline is a presumption in favor of industrial/economic pursuits. Under this baseline, regulated interests begin with a presumptive entitlement. *Id.* The third such baseline is a presumptive entitlement assigned to those who stand to benefit from the regulatory program. *Id.* In other words, the third baseline is a presumption in favor of environmental protection. Farber asserts that the environmental baseline is the appropriate baseline to use.

104. FARBER, *supra* note 16, at 94. Farber has been criticized for overstating the public commitment to environmental protection. See Paul Boudreaux, *Environmental Costs, Benefits, and Values: A Review of Daniel A. Farber's Eco-Pragmatism*, 13 TUL. ENVTL. L.J. 125, 148-49 (1999) (asserting that Farber has "overstretched" and that although Americans like to label

nature has inherent value that goes far beyond the purely utilitarian uses of nature for human purposes.¹⁰⁵ Other justifications for an environmental baseline include: limited scientific understanding, enormous data gaps, complexity, and uncertainty of environmental issues.¹⁰⁶ Without a full understanding of the complex issues involved, prudence suggests a presumption in favor of environmental protection. Consequently, environmental law should take a stance in favor of environmental protection instead of attempting to be neutral. Under eco-pragmatism, there is a presumption in favor of environmental protection, but the presumption can be rebutted where the costs of protecting the baseline are disproportionately large.¹⁰⁷

Deciding to establish an “environmental baseline” raises the issue of what is an environmental baseline, particularly in the area of ecological protection. Is the environmental baseline a zero-risk baseline, or is some other measure of environmental protection more appropriate? Farber does not attempt to answer this question. In the area of ecological protection, establishing an environmental baseline takes on additional complexity beyond that of human health protection.¹⁰⁸ This Article proposes maintenance of ecological integrity as an environmental baseline. One significant component of ecological integrity is biodiversity—a measure of species abundance and richness used by

themselves as environmentalists, the depth of their commitment is unclear). Nevertheless, there are numerous surveys and studies that consistently demonstrate the existence of such a commitment. For a general discussion of American environmental values and public opinion surveys regarding such values, see ROBERT V. PERCIVAL, CHRISTOPHER H. SCHROEDER, ALAN S. MILLER & JAMES P. LEAPE, *ENVIRONMENTAL REGULATION: LAW, SCIENCE AND POLICY* 8 (4th ed. 2003). One recent study conducted by the Yale Center for Environmental Law and Policy indicates that most Americans are seriously concerned about the country's environmental health and want more attention paid to environmental problems. This survey also suggests that most Americans, whether Democrat, Republican, or Independent, are as concerned with problems of air pollution and toxic contamination of soil and water as they are with issues of jobs and the cost of gas. See YALE CTR. FOR ENVTL. LAW & POLICY, YALE UNIV. SCH. OF FORESTRY & ENVTL. STUDIES, *THE ENVIRONMENTAL DEFICIT: SURVEY ON AMERICAN ATTITUDES ON THE ENVIRONMENT* (2004), http://www.yale.edu/forestry/downloads/yale_enviro_poll.pdf.

105. Moreover, to the extent to which nature provides utility, it is a public good that should not be frivolously plundered to benefit a few. FARBER, *supra* note 16, at 108–09.

106. *Id.* at 12.

107. *Id.* Although beyond the scope of this article, Farber also asserts that the ecological baseline should be adopted by the judicial system as canon of statutory interpretation, which he refers to as a “green canon.” *Id.* at 124. Farber looks to legislative intent, as well as to the more formalistic view of the statutory mandate of NEPA, for the government to use all practicable means consistent with other essential considerations of national policy to achieve certain prescribed environmental goals, as bases for his green cannon. *Id.* at 124–27.

108. For example, in human health protection, a “no carcinogenicity” baseline could be established. Alternatively, a *de minimis* risk baseline could be established (e.g., a baseline of one cancer death per million). Other approaches could include establishing a baseline that is no greater than the risk from ambient pollutant levels. In the ecological arena, however, the issues are more complex.

ecologists to assess the health of ecosystems.¹⁰⁹ In addition to having considerable scientific justification for protecting biological diversity, it is important to remember that protection of biodiversity is mandated under international law. The 1992 United Nations Environment Programme Convention on Biological Diversity¹¹⁰ ("Convention") created the first international obligation to protect biodiversity. However, although the United States is a signatory, the Convention has not been ratified, and therefore the United States is not formally bound by it. Nevertheless, article 18 of the Vienna Convention on the Law of Treaties provides that a state that has signed a treaty must refrain from "acts that would defeat the object and purpose of the [t]reaty."¹¹¹ Accordingly, the United States is arguably prohibited from taking any action that would defeat the purpose of the 1992 Convention to Protect Biological Diversity.¹¹² Accordingly, at least some basis in international law supports an argument that the United States is obligated to conserve biological diversity.

U.S. domestic law also supports an ecological integrity baseline. Various statutes express goals and policies directed toward maintenance of ecological integrity. For example, the Clean Water Act provides the broad environmental objective "to restore and maintain the chemical, physical, and biological integrity of the nation's waters."¹¹³ Perhaps the

109. Professor Fred Bosselman has published a comprehensive analysis of scientific issues that biologists recognize as inherent in the concept of "biodiversity." He maintains that the term "biodiversity" lacks the precision needed for a workable legal standard and sets out to provide a series of example to illustrate the various approaches that the law could take to address these scientific issues. Fred Bosselman, *A Dozen Biodiversity Puzzles*, 12 N.Y.U. ENVTL. L.J. 364 (2004).

110. United Nations Convention on Biological Diversity, June 5, 1992, S. TREATY DOC. 20 (1993), 31 I.L.M. 818 (1993).

111. May 23, 1969, 1155 U.N.T.S. 331.

112. Moreover, as Professor Daniel Tarlock has pointed out, Chapter 15 of Agenda 21, which was approved by the United Nations Conference on Environment and Development, obligates states to develop strategies to conserve biodiversity and for sustainable use of biological resources. A. Dan Tarlock, *Biodiversity Conservation in the United States: A Case Study in Incompleteness and Indirection*, 23 ENVTL. L. REP. 10529 (2002).

113. 33 U.S.C. § 1251(a) (2000). See also 42 U.S.C. § 7401 (2000) (expressing one of the objectives of the Clean Air Act as being to protect the public health and welfare from adverse effects of air pollution). For further discussion of U.S. authorities that support an ecological integrity baseline, see also Robert L. Fischman, *Biological and Ecological Management: Biological Diversity and Environmental Protection: Authorities to Reduce Risk*, 22 ENVTL. L. 435 (1992). In addition to the specific provisions related to ecological integrity that can be found in domestic environmental pollution control laws, several commentators have argued that other areas of the law support the protection of ecological or biological integrity. See, e.g., Robert L. Fischman, *The Meanings of Biological Integrity, Diversity, and Environmental Health*, 44 NAT. RESOURCES J. 989 (2004) (analyzing the National Wildlife Refuge mandate "to ensure that the biological integrity, diversity, and environmental health of the (Refuge) System are maintained"); and Terry W. Frazier, *Protecting Ecological Integrity Within the Balancing Function of Property Law*, 28 ENVTL. L. 53 (1998) (arguing that ecological integrity should be a

strongest support for such a baseline, however, can be found in the National Environmental Policy Act (NEPA).¹¹⁴ Section 101 of NEPA provides, among other things, that it is the continuing policy of the United States to “create and maintain conditions under which man and nature can exist in productive harmony.”¹¹⁵

While biodiversity certainly is an important indicator of ecosystem health, ecosystem health also relies on the integrity of the physical and chemical components of the system, as well as the relationship between species and the physical world. Of course, one measure of ecological integrity is the presence of a diversity of species. Nevertheless, not all species within an ecosystem provide the same level of value to the other members of the ecosystem. Conservation biologists have identified certain types of species that provide greater value to ecosystems and accordingly should be afforded greater protection. One such type of species, the “controller species,” plays a major role in controlling the movement of energy and nutrients within an ecosystem.¹¹⁶ Another type of species of special importance is known as the “keystone species,” which provides more value to the ecosystem than would be predicted by their limited abundance in the ecosystem.¹¹⁷ Some conservation biologists believe that the extinction of a keystone species could result in a domino effect whereby numerous species go extinct and the entire ecosystem is drastically altered.¹¹⁸ “Umbrella species” typically have very large home territories such that protecting an umbrella species’ habitat will have the

guiding principle by which legislatures, courts, and administrative agencies interpret and apply property rules).

114. 42 U.S.C. § 4321–4347 (2000).

115. *Id.* § 4331. This section declares it is the policy of the United States to use all practicable means to achieve a list of broad environmental goals. These goals include:

1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; 2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; 3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; 4) preserve important historic cultural and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice; 5) achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life’s amenities; and 6) enhance the quality of renewable resources and approach the maximum obtainable recycling of depletable resources.

Id. For a detailed discussion of the possible use of NEPA as an environmental baseline that can inform statutory interpretation, see generally Mary Jane Angelo, *Crouching Textualist, Hidden Intentionalist: Reclaiming Our Stolen “Green Destiny” out of the Judicial Sparring over the Interpretation of Environmental Statutes*, in STRATEGIES FOR ENVIRONMENTAL SUCCESS IN AN UNCERTAIN JUDICIAL CLIMATE (Michael Allan Wolf ed., 2005).

116. Controller species typically include decomposer species. HUNTER, *supra* note 29, at 52.

117. One commonly cited example of a keystone species is the red-cockaded woodpecker, which “excavates cavities in living trees, thereby providing habitat” for a variety of species that live in tree cavities but are not capable of excavating their own cavities. *Id.*

118. *Id.* at 74.

effect of protecting many other species as well.¹¹⁹ Finally, species very sensitive to pollutants and other environmental stresses—such that the health of these populations serves as a good indicator of overall ecological health—are known as “indicator species.”¹²⁰ Of course, while certain types of species—such as controller species and keystone species—may warrant greater protection, due to our extremely limited understanding of the workings of ecological systems, a prudent environmental baseline would assume that every component of an ecosystem has some value unless proven otherwise.¹²¹

Moving beyond protection of individual species, even those of particular ecological import, the protection of ecosystem¹²² diversity is crucial to the maintenance of overall ecological integrity. Ecosystems themselves provide numerous services,¹²³ some easily quantifiable and some not. As Professor Laura Westra has stated, “[h]uman survival depends on many of nature’s ‘goods and services’ that are invisible to markets and the economy; some are no doubt invisible to scientists.”¹²⁴ Natural resource economists have identified numerous ecosystem services that would be extremely expensive if not technically infeasible for humans to replace. In fact, global ecosystem services have been valued at \$33 trillion.¹²⁵ Of course, as with individual species, a lack of

119. *Id.* at 54.

120. *Id.* at 55. The pelican’s sensitivity to DDT made it a good indicator species for organochlorine pesticide contamination.

121. DAVID S. WILCOVE, *THE CONDOR’S SHADOW: THE LOSS AND RECOVERY OF WILDLIFE IN AMERICA* 12 (1999). Both individual species and ecosystems exhibit a wide range of resilience to human-induced changes. *Id.* at 6. Because of the dramatic differences between species and between ecosystems and because so little is understood about the ability of a particular species or particular ecosystem to tolerate or bounce-back after damage from human activities, it is very difficult to determine whether a particular change will result in significant habitat destruction. *Id.* at 9. While saying that all ecosystems are so delicate and intricate that removing one part will necessary cause the demise of the entire system may be gross overstatement, it is not overstatement to say that removing one species from an ecosystem can negatively affect other species and, in the words of Princeton conservation biologist David Wilcove, “there is no way of knowing ahead of time where the chain reaction will end.” *Id.* at 12.

122. An ecosystem is defined as “a group of interacting organisms (often called a community), and the physical environment they inhabit at a given point in time. HUNTER, *supra* note 29, at 62 (emphasis removed).

123. One example of an ecosystem service is a wetland (a type of ecosystem) serving as a filter to treat water supplies. *Id.* at 69. Other examples include beach dunes buffering upland properties from the effects of storms, and saltmarshes supporting fisheries, air purification, soil renewal, climate stabilization, and crop pollination. *Id.*; see also Ruhl, *supra* note 11, at 544 (citing *NATURE’S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS* (Gretchen C. Daily ed., 1997)).

124. Laura Westra et al., *Ecological Integrity and the Aims of the Global Integrity Project*, in *ECOLOGICAL INTEGRITY: INTEGRATING ENVIRONMENT, CONSERVATION, AND HEALTH* 25 (David Pimentel et al. eds., 2000).

125. FARBER, *supra* note 16, at 67 (describing a 1997 report in the scientific journal *NATURE*); see also Robert Costanza et al., *The Value of the World’s Ecosystem Services and Natural Capital*, 387 *NATURE* 253 (1997).

understanding of the workings of these complex systems leaves open the very likely possibility that ecosystems perform many other valuable services that we do not yet fully understand or are not yet able to quantify.

Because ecology encompasses the relationships between the physical, the chemical, and the biological, ecological integrity necessarily includes physical integrity, chemical integrity, and biological integrity. To fully address ecological integrity, a variety of indicators of ecosystem health must be considered, including not only the number of organisms or species or the status of threatened or endangered species, but also the state of physical, chemical, and biological processes that, together with biological considerations, comprise ecological integrity. Ecological integrity can be measured by starting with looking "at a site with a biota that is the product of evolutionary and biogeographic processes in the relative absence of the effects of modern human activity."¹²⁶ Then, existing or predicted conditions can be compared to this baseline to measure the extent of deviation. Conservation biology scholars have made numerous attempts to define qualitatively, if not quantitatively, biological or ecological integrity. For example, James R. Karr developed an index of biological integrity (IBI) to address the objective articulated in the Clean Water Act,¹²⁷ "to restore and maintain the chemical, physical, and biological integrity of the Nations Waters."¹²⁸

Whatever metrics are employed to evaluate whether an environmental regulatory program preserves ecological integrity, some system of measurement is needed to account for diversity, health of significant species, and integrity of the physical and chemical world. By clarifying that ecological integrity will be the environmental baseline in eco-pragmatism, a clear reference point can be established to which ecological changes of proposed anthropogenic activities can be measured against. Accordingly, when considering whether to impose a regulation, the regulation must be sufficient, not to completely preserve the status quo, but to maintain ecological integrity.

126. Westra, *supra* note 124, at 23.

127. 33 U.S.C. § 1251(a) (2000).

128. James R. Karr, *Health, Integrity, and Biological Assessment: The Importance of Measuring Whole Things*, in Westra, *supra* note 124, at 209, 219–23. The IBI has been compared to the index of leading economic indicators, which considers a number of financial measures to assess the overall state of the economy. Similarly, the IBI takes into consideration a number of metrics to assess the overall condition of an ecological system. Examples of metrics used in determining the IBI include species richness, stress intolerant and tolerant indicator species, relative abundance of trophic guilds, presence of alien species, and the incidence of disease, lesions, tumors, or other anomalies in the biota. The IBI does not call for the measurement of physical or chemical parameters but instead assumes that their impacts will be manifest in biological indicators. Because of the regional differences between ecological systems, the IBI must be calibrated on a regional basis. *Id.*

4. *Lack of Information and Changing Information*

The fourth question sought to be answered by eco-pragmatism is when should we proceed in the face of imperfect information rather than waiting for a better understanding of environmental issues after new information becomes available. This question raises the related issues of whether precautionary approaches should be used in environmental decision-making and how to incorporate adaptive management ideas into environmental laws.

The lack of scientific understanding of natural systems overshadows the entire environmental decision-making process.¹²⁹ Science's limited ability to provide clear answers to environmental questions has presented ongoing problems in environmental law.¹³⁰ As described by Justice Breyer, scientific uncertainty is involved in every stage of any risk assessment. As he describes it, if ten independent steps in a risk analysis each involves an uncertainty factor of two, the estimate of the total risk has an uncertainty factor of one thousand.¹³¹ Even beyond the complex field of risk assessment, uncertainty pervades environmental decision-making.¹³² The regulated community has taken full advantage of this scientific uncertainty. Decisions to regulate, the community asserts, should wait until science can conclusively demonstrate the need for such regulation.¹³³ Of course, using a lack of certainty as an excuse not to act can result in serious, and sometimes irreparable, environmental consequences.

Our limited understanding of environmental issues, coupled with the complexity of ecological systems, suggests caution when deciding whether to allow potentially risky activities. The precautionary principle, adopted by a variety of international environmental agreements,¹³⁴ is one

129. FARBER, *supra* note 16, at 1, 5.

130. See Tarlock, *supra* note 33, at 1135 (discussing the tension between scientific uncertainty and the law's desire for clear standards).

131. FARBER, *supra* note 16, at 163 (citing Breyer, *supra* note 46, at 45).

132. See, e.g., Tarlock, *supra* note 33, at 1135-39.

133. See, e.g., *id.* at 1135-36.

134. See, e.g., Treaty on European Union, Feb. 7 1992, 31 I.L.M. 247 (hereinafter Maastricht Treaty) (adopting the precautionary principle as a governing principle of European Union Law). See also 1992 United Nations Environment Programme Convention on Biodiversity. The preamble to the Cartagena Protocol on Biosafety provides that it is

reaffirming the precautionary approach . . . contained in . . . the Rio Declaration on Environment and Development . . . Article 10(6) of the Protocol provides that [l]ack of scientific certainty due to insufficient relevant scientific information and knowledge regarding potential adverse effects of a living modified organism on the conservation and sustainable use of biological diversity in the Party or import . . . shall not prevent that Party from taking a decision, as appropriate, . . . in order to avoid or minimize such potential adverse effects.

Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Jan. 29, 2000, 39 I.L.M. 1027, 1031 (2000).

approach to proceeding cautiously. The precautionary principle resolves scientific doubts in favor of the environment.¹³⁵

As predictions are made further out in time, uncertainty tends to increase. Accordingly, more caution is warranted when considering effects that may not occur until long into the future. Moreover, the precautionary principle takes into account the fact that inherent in any scientific evaluation is the opportunity for scientific error to occur.¹³⁶ Opponents of the precautionary principle contend that it is based on vague and baseless fears regarding environmental risks. But, the same could be said to argue in favor of a precautionary approach. Often the costs of regulation are based on vague and baseless fears about the potential economic consequences of regulation, dire predictions of which rarely come true.¹³⁷

Farber emphasizes the need to proceed cautiously. He maintains that, when environmental risks are still uncertain, we should take reasonable precautions.¹³⁸ When making difficult regulatory decisions with very incomplete or inconclusive data is necessary,¹³⁹ waiting until complete or conclusive data are available may be imprudent. For many environmental decisions, a decision to wait is a decision to irreversibly impact a resource. Such is the case with a decision to withhold regulatory action on the protection of an endangered species due to incomplete information. By the time complete information becomes available, the species may be extinct or beyond recovery.

Because the ecological sciences are relatively new, scientific uncertainty is perhaps even more profound in assessing risks to ecological systems than in assessing human health risks.¹⁴⁰ Once again, the incorporation of ecological principles into eco-pragmatism lends further support to the theory. Moreover, with regard to ecological issues, flexible and adaptive approaches are even more critical than with human health concerns. The science of understanding how species and ecosystems work

135. Ruhl, *supra* note 11, at 537.

136. Scientific type I errors are those that mistakenly conclude an effect is real when it is not, whereas type II errors are those that mistakenly conclude that an effect is not real when it really is. In the field of environmental protection, type II errors are of the greatest concern. If, for example, a determination is made that allowing a particular activity to proceed will not cause harm to an endangered species, and that decision is based on a type II error, the activity may unintentionally result in jeopardy to the endangered species. FARBER, *supra* note 16, at 173.

137. Another way to view the precautionary principle is as a burden-shifting device, which shifts the burden of proof to the resource users or polluter to demonstrate its activities should be allowed. *Id.* at 171. By placing the burden of proof on the regulated entity, ties are resolved in favor of the environment.

138. *Id.* at 164.

139. *Id.*

140. See generally Daniel A. Farber, *Probabilities Behaving Badly: Complexity Theory and Environmental Uncertainty*, 37 U.C. DAVIS L. REV. 145 (2003) (describing the high level of scientific uncertainty surrounding environmental problems).

and how human disruptions may impact them is still in its infancy.¹⁴¹ During the early years of ecology natural systems were believed to be stable and ecosystems were thought to have evolved in a predetermined set of stages (known as succession) toward a stable "climax community."¹⁴² In the past twenty-five years, the paradigm that ecosystems exist in a state of equilibrium has been replaced with the more complex nonequilibrium paradigm.¹⁴³ In recent years, ecological science has discovered that natural systems have multiple persistent states and multiple "successional pathways." In other words, natural systems do not necessarily follow a clear path from successional state to successional state but instead may follow a variety of different paths.¹⁴⁴ Thus, the current dominant paradigm rejects the "balance of nature" paradigm.¹⁴⁵ To capture this concept, Professor Judy Meyer has coined the phrase "dance of nature" to replace the outdated "balance of nature."¹⁴⁶ In the past twenty years, ecologists also have begun to realize that natural systems are episodically and repeatedly disturbed by natural phenomena such as fire, flood, drought, and disease and pest outbreak, as well as by similar types of disturbances resulting from human activity.¹⁴⁷ Functioning ecosystems have a certain level of resilience and resistance to such disturbances. Consequently, human disturbances that mimic these natural disturbances are not necessarily "bad" for natural systems.¹⁴⁸ The goal for

141. FARBER, *supra* note 16, at 167. Professors Bosselman and Tarlock review four periods of ecological thought during the twentieth century and analyze how each period influenced environmental law and policy. Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 CHI.-KENT L. REV. 847 (1994).

142. See generally Meyer, *supra* note 26, at 876.

143. See generally BOTKIN, *supra* note 26. The nonequilibrium paradigm was not widely accepted until the 1980s. See Tarlock, *supra* note 33, at 1129.

144. Meyer, *supra* note 26, at 876.

145. *Id.* at 877.

146. *Id.*

147. *Id.* at 876.

148. Ruhl, *supra* note 20, at 906-07. Despite the complex and delicate nature of interactions between species in an ecosystem, both history and disequilibria theory teach that change, including human disturbance, is not necessarily detrimental to overall ecosystem health. Ecosystems do possess the ability to resist certain disturbances and to recover from those that do have a detrimental effect. In ecological terms, "resistance" is the degree to which an ecosystem changes in response to a disturbance whereas "resilience" is the degree to which an ecosystem recovers after it has been disturbed. HUNTER, *supra* note 29, at 74. Thus, while not all human disturbance is detrimental to ecosystems, the frequency of the disturbance, the magnitude of the disturbance, and the nature of the disturbance determine whether the ecosystem will suffer long-term negative effects. Meyer, *supra* note 26, at 882. Ecosystems tend to respond better to human disturbances that mimic those that occur in nature. In addition, the overall health of an ecosystem determines how well the ecosystem will respond to disturbances. For example, species-rich areas may be both more resistant and more resilient to human disturbances than ecosystems lacking a great abundance and diversity of species. HUNTER, *supra* note 29, at 86-91. Genetic variability within a species improves the likelihood that the species will survive and evolve in response to environmental change. *Id.* at 86-87. Likewise, variability between species within an ecosystem can improve the chances for an ecosystem to survive and evolve in response

environmental protection, thus, should not be to suppress all human-caused disturbances, but rather to prevent human-caused disturbances that are not in line with the natural disturbance regime of the ecosystem.¹⁴⁹ To proceed consistently with natural disturbance regimes, therefore, requires knowledge of the historical record of an ecosystem.¹⁵⁰ Unfortunately, this type of long-term historical monitoring data rarely is available.

The non-equilibrium paradigm, however, should not be understood to imply that, because ecosystems naturally experience change, all anthropogenic change is acceptable.¹⁵¹ Anthropogenic changes frequently differ from natural changes in character, magnitude, and frequency.¹⁵² Moreover, natural systems frequently react to anthropogenic disturbances in unpredictable ways.¹⁵³ Even very small disturbances can “flip” ecosystems into vastly different behavioral states, sometimes well after the event that started the reaction.”¹⁵⁴ Thus, as Meyer concludes, “[a]nthropogenic change is acceptable only if that change is within limits.”¹⁵⁵ The limits depend on the specifics of the ecosystems and its ability to keep pace with the changes that occur.¹⁵⁶

In addition to precautionary approaches, eco-pragmatism favors developing flexible regulatory systems that allow decisions to be modified as additional information becomes available.¹⁵⁷ One of the most significant aspects of pragmatism in general is the recognition that the combination of limited information and an ever-changing society cannot tolerate static decision-making. Instead, mechanisms must be in place to ensure that, as new information becomes available or as society’s values evolve, the law must be able to adapt incrementally and accordingly.¹⁵⁸

to human disturbances. *Id.* In fact, a lack of genetic diversity may cause problems even in ecosystems not experiencing change. For example, genetically uniform species may experience low fertility and high mortality rates among offspring, as evidenced by the experiences in many zoos. *Id.* at 88. Likewise, ecosystems that have not been compromised by chemical contamination may respond better than those that have.

149. Meyer, *supra* note 26, at 879.

150. *Id.* at 879.

151. *Id.* at 882. See also Tarlock, *supra* note 33, at 1130 (explaining that the nonequilibrium paradigm does not undermine the case for protection of ecosystems).

152. Meyer, *supra* note 26, at 882.

153. See Ruhl, *supra* note 20, at 906.

154. *Id.* This phenomenon is frequently analogized with the “tipping” point of a canoe. A canoe can be progressively tipped more and more with only minor effect, until it reaches its tipping point, at which point the canoe completely capsizes. Once a tipping point is reached, the entire system can collapse or undergo dramatic change.

155. Meyer, *supra* note 26, at 882.

156. *Id.* at 882.

157. FARBER, *supra* note 16, at 12.

158. See, e.g., SHAPIRO & GLICKSMAN, *supra* note 11, at 24–27. Shapiro and Glicksman have referred to such incremental adjustment as “muddling through” and argue that it is often

Thus, eco-pragmatism suggests that environmental laws must have mechanisms built into them to allow regulatory agencies to make incremental adjustment to regulation to take into account new information, as well as to correct old mistakes.¹⁵⁹ Under the existing regulatory system, agencies such as EPA tend to be so concerned with making the “right” decision up front, that any controversy or lack of information tends to paralyze them. Instead, a pragmatic approach would enable agencies making the best available decision based on the best currently available information with a corresponding recognition that such decisions will be adjusted over time.¹⁶⁰ Of course, one reason that agencies are so concerned with making the perfect front-end decisions is that changing course in mid-stream is generally extremely difficult and time-consuming under the existing regulatory system.¹⁶¹

The inherent complexity and unpredictability of natural systems,¹⁶² coupled with a limited scientific understanding of such systems, has led to the ground-breaking development in the field of conservation biology called adaptive management.¹⁶³ Adaptive management developed in the context of natural resource management.¹⁶⁴ Nevertheless, it has not yet been used widely in environmental regulation.¹⁶⁵ Adaptive management requires both a willingness to make environmental policy decisions with limited scientific information and recognition that such decisions must be continually monitored, evaluated, and adjusted as new information or changed circumstances warrant.¹⁶⁶

the most rational way to make policy. *Id.* at 24. In fact, pragmatism shies away from dramatic reforms in favor of such incremental adjustments. *Id.* at 26.

159. *Id.*

160. *See id.* at 25. Willingness to change as new information becomes available must work both ways—i.e., on the one hand, if a regulation is found not to be protective enough, a mechanism should adapt quickly to provide the requisite protection. If a regulation is too stringent, a mechanism should provide quick regulatory relief. FARBER, *supra* note 16, at 12.

161. The stasis inherent in the regulatory system stems in part from the time-consuming and cumbersome requirements of the Administrative Procedure Act, 5 U.S.C. §§ 551–559 (2000), the agencies’ fear that any “opening up” of the rulemaking process will invite legal challenges, and the expectation on the part of the regulated community that once a decision is made, they will be able to rely on it indefinitely.

162. The developing theory of dynamic systems is also referred to as complexity theory or chaos theory. *See* FARBER, *supra* note 140, at 146. Farber’s article explores the uncertainty about environmental problems in the context of complexity theory. Farber posits that complexity theory provides strong support for adaptive management. *Id.* at 147.

163. For a detailed discussion of adaptive management and how it is used in a number of environmental programs, including Habitat Conservation Planning under the ESA, U.S. Forest Service management planning, and everglades restoration, see Bradley C. Karkkainen, *Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward a Bounded Pragmatism*, 97 MINN. L. REV. 943 (2003).

164. SHAPIRO & GLICKSMAN, *supra* note 11, at 167.

165. *Id.*

166. *Id.* Previous experience is used to inform adjustments to policy. Perhaps Bosselman and Tarlock said it best:

More flexible regulatory systems are needed to adapt to change or to incorporate new information. In addition, regulatory systems must place greater emphasis on acquiring necessary data through monitoring outcomes of environmental decisions. Using the information of the effects of a particular regulatory action acquired through monitoring programs, adjustments can be made to produce better, more science-based regulations.¹⁶⁷ Eco-pragmatism calls for a more experimental approach in which regulatory actions are implemented, monitored, and adjusted based on the results of the monitoring.¹⁶⁸

The difficulty with these types of flexible or adaptive schemes is that neither the law nor the regulatory agencies that implement the law are quick reactors to change. Eco-pragmatism attempts to address this problem by proposing more decentralized approaches whereby decisions can be modified to adapt to new information on a local level and smaller scale more quickly than could be accomplished in a large centralized system.¹⁶⁹ A decentralized system tends to be more flexible and to respond more quickly to new information.¹⁷⁰ One mechanism for accomplishing decentralization is devolution of regulatory responsibility to state and local governments. However, although localized decision-making has certain advantages, delegating too much authority to states or local governments could result in a "race to the bottom."¹⁷¹ Thus, safeguards are necessary to prevent a disintegration of environmental protection. Such safeguards could include national minimum standards and national oversight of state regulation.¹⁷²

Ecosystems are patches or collections of conditions that exist for finite periods of time [footnote omitted]. The accelerating interaction between humans and the natural environment makes it impossible to return to an ideal state of nature. At best, ecosystems can be managed rather than restored or preserved, and management will consist of a series of calculated risky experiments . . .

that must be judged against a moving target.

Bosselman & Tarlock, *supra* note 39, at 869–70. Although environmental experimentation is rife with risk, it may be the only effective way to proceed. For any system or organization to adjust to changing information or circumstances, feedback loops are necessary. *See* Tarlock, *supra* note 33, at 1139. To date, such feedback loops have not been widely used in environmental law, which tends to favor the consistency and predictability of clear fixed rules. *Id.* In fact, environmental law has tended to adhere so strongly to scientific findings that it fails to reconsider such findings even as new data prove them to be incorrect. *Id.* at 1039–40.

167. FARBER, *supra* note 16, at 179.

168. *Id.*

169. *Id.* at 180.

170. Ruhl, *supra* note 11, at 540.

171. FARBER, *supra* note 16, at 182–83. For an excellent analysis of the race to the bottom theory, see Kirsten H. Engel, *State Environmental Standard-Setting: Is There a "Race" and is it to the "Bottom"?*, 48 HASTINGS L.J. 271 (1997). For an opposing view of the theory, see Richard L. Revesz, *The Race to the Bottom and Federal Environmental Regulation: A Response to Critics*, 82 MINN. L. REV. 535 (1997).

172. FARBER, *supra* note 16, at 182–83.

In sum, eco-pragmatism provides a useful framework for environmental decision-making. Many of the shortcomings of eco-pragmatism can be overcome by consciously integrating principles of ecological science. An eco-pragmatic evaluation of pesticide law must start with an understanding of the history of pesticide use and the ecological risks posed by pesticides.

II. THE HISTORY OF THE PESTICIDE/ECOLOGY RELATIONSHIP

A. History of Pesticide Use

Scientists believe that humans have used pesticides for over two thousand years.¹⁷³ Although metals such as arsenic, lead, and copper were used as pesticides extensively in the early twentieth century, most pest control until that time was accomplished by cultural controls such as cultivation,¹⁷⁴ sanitation,¹⁷⁵ crop rotation,¹⁷⁶ and sowing and harvesting practices.¹⁷⁷ Not until the latter half of the twentieth century did the

173. Homer described how Odysseus used burning sulfur as a fumigant to control pests. HOMER, *THE ODYSSEY* (Edward McCrorie transl., 2004). For a more complete description of the history of pesticide use, see Clive A. Edwards, *The Impact of Pesticides on the Environment*, in *THE PESTICIDE QUESTION*, *supra* note 62. Additional documentation of pesticide use such as the use of arsenic to kill insects can be found in literature dating back to the time of Christ. There is documentation that arsenic has been used to control insects dating back to 70 A.D. when Pliny the Elder recommended the use of arsenic to kill insects. Arsenic was also used as a pesticide in sixteenth century China. *Id.*

174. HELMUT F. VAN EMDEN & DAVID B. PEAKALL, *BEYOND SILENT SPRING: INTEGRATED PEST MANAGEMENT AND CHEMICAL SAFETY* 115–17 (1996). Many pest insects live out at least part of their life cycle in soil, weeds, or accumulated crop debris in farm fields. Plowing the top layer of soil kills many of these pest insects. Accordingly, soil tillage historically was a critical component of agricultural pest management. It was not until relatively recently that, as a way to minimize soil erosion, tillage was abandoned in favor of zero or minimum tillage systems, which rely on herbicide usage to control weeds. The demise of tillage as a core component of modern agricultural systems has resulted in a dramatic increase in certain soil-dwelling pests. *Id.* at 115. Other cultivation pest control techniques used historically include mulching, compacting, and manuring. *Id.* at 115–17.

175. Sanitation practices are one of the most effective pest control practices used in both ancient and modern agriculture. *Id.* at 117–18. By destroying residues of crops left in fields after harvesting, many pest populations that live in such residues are destroyed. Related practices such as destruction of weed hosts and selective pruning also serve as effective pest control tools. *Id.* at 118–19.

176. Crop rotation, one of the oldest forms of pest control, is a very effective pest control technique for minimizing soil-dwelling pests. By alternating the planting of different crops in a particular field, populations of soil-dwelling insects that feed on a particular crop will not be able to build up during periods when their food crop is not present. Thus, when the crop eventually is planted, populations of the pest species generally will not be high enough to cause serious problems. *Id.* at 120–21.

177. Timing sowing and planting dates to avoid pest outbreaks or to ensure the crop plant is in a resistant growth stage when pest outbreaks are likely to occur, as well as carefully tailoring seed and planting rates and early harvesting can be effective tools for avoiding pest damage to crops. *Id.* at 121–23.

development of synthetic chemical pesticides lead to a global explosion of pesticide use.¹⁷⁸ Because these new synthetic chemical pesticides were spectacularly effective at controlling a wide variety of pests, they quickly gained favor and, before long, were ubiquitous. Estimates of global pesticide use are staggering. More than 1,600 types of pesticides are currently available.¹⁷⁹ More than five billion pounds of pesticides, with a value of over thirty billion dollars, are used annually in the world.¹⁸⁰ Pesticide use in the United States accounts for 27 percent of global pesticide usage, with U.S. exports to other countries exceeding 450 million pounds of pesticides per year.¹⁸¹

The rapid worldwide adoption of synthetic chemical pesticides began during World War II with the development of two primary categories of chemical insecticides: the organochlorines and the organophosphates. The organochlorines, which include the notorious pesticide DDT,¹⁸² were first considered highly desirable because, while very toxic to a broad range of invertebrates, they are not highly acutely toxic to humans or other mammals.¹⁸³ Organochlorine pesticides such as DDT are credited with saving thousands of lives from insect-borne diseases during World War II.¹⁸⁴ Furthermore, these pesticides also are extremely persistent in the environment, which makes them highly effective for long-term effective pest control. However, their persistence became their downfall when the long-term ecological consequences of these pesticides became apparent. It soon became evident that these pesticides accumulated in living tissues and bioconcentrated as they moved through the food chain.¹⁸⁵ This resulted in serious impacts to predators at the top of the food chain including the American Bald Eagle. Consequently, most organochlorine pesticides were either banned or severely restricted, at least in the developed countries of the world.¹⁸⁶

178. Edwards, *supra* note 173, at 13.

179. These figures are based on EPA pesticide market estimates for the years, 2000–2001. See E.P.A., PESTICIDE INDUSTRY SALES AND USAGE, 2000 AND 2001 MARKET ESTIMATES (May 2004), http://www.epa.gov/oppbead1/pestsales/01pestsales/market_estimates2001.pdf.

180. *Id.*

181. Edwards, *supra* note 173, at 13.

182. DDT is the abbreviation for synthetic insecticide, 1, 1, 1-trichloro-2, 2-bis (*p*-chlorophenyl) ethane. ROBERT E. PFADT, FUNDAMENTALS OF APPLIED ENTOMOLOGY 755 (3d ed. 1978).

183. Edwards, *supra* note 173, at 14.

184. Andrew P. Morriss & Roger E. Meiners, *Property Rights, Pesticides, and Public Health: Explaining the Paradox of Modern Pesticide Policy*, 14 FORDHAM ENVTL. L. Rev. 1, 6 (2002).

185. Stevens Indus., Inc., 1 E.A.D. 9, 16 (June 2, 1972) (Consolidated DDT Hearings).

186. Edwards, *supra* note 173, at 14. A number of international agreements exist to restrict the use of persistent organic pollutants, such as the organochlorine pesticides. For a detailed discussion of such agreements, see Michael P. Walls, *International Chemicals Update 2005*, SK 058 A.L.I.-A.B.A. COURSE OF STUDY MATERIALS 661 (2005). It should be noted that there has

The other major category of pesticides developed during World War II is organophosphate pesticides, initially developed as wartime nerve gases.¹⁸⁷ Although these pesticides have the environmental advantage of being far less persistent in the environment than organochlorine pesticides, organophosphates tend to be highly acutely toxic to humans, other mammals, and birds.¹⁸⁸ These pesticides became the pesticides of choice in the United States after most organochlorine pesticides were banned or severely restricted. Organophosphates remain the largest category of chemical insecticide in use in the United States today.¹⁸⁹ In addition to posing risks of acute poisoning to farm workers, these pesticides have been implicated in a large number of avian and wildlife poisonings.¹⁹⁰

Although, from an ecological standpoint, narrow-spectrum pesticides are preferable, broad-spectrum synthetic pesticides continue to dominate U.S. pesticide usage.¹⁹¹ This phenomenon is at least in part attributed to the time and costs associated with bringing a new pesticide to the market.¹⁹² The average time to bring a new pesticide to commercialization is five to ten years with an associated cost of ten to twenty million dollars.¹⁹³ Moreover, the average life-span of a pesticide for a specific use is ten years.¹⁹⁴ Accordingly, pesticide manufacturers may be inclined to

been a recent resurgence in efforts to loosen restrictions on DDT due to its potential use in combating malaria and other insect-borne diseases. See, e.g., Morriss & Meiners, *supra* note 184.

187. Edwards, *supra* note 173, at 15.

188. *Id.*

189. See E.P.A., *supra* note 179.

190. *Id.* Other categories of chemical pesticides include the synthetic pyrethroids and carbamates. Pyrethrum is a naturally occurring pesticide derived from chrysanthemum flowers. *Id.* Synthetic pyrethroids are synthetically produced versions of pyrethrum. These pesticides have the environmental benefit of having very low mammalian toxicity and low environmental persistence. *Id.* Nevertheless, they are highly toxic to a broad range of invertebrates, including many beneficial insects. *Id.* They are also highly toxic to fish and other aquatic organisms. Carbamates are more persistent than organophosphates in the environment and are generally broad-spectrum, having adverse impacts on many different groups of organisms. *Id.* Other commonly used pesticides are: nematocides, which not only are of high mammalian toxicity and broad-spectrum but also are very transient in soil; herbicides, which generally are not highly toxic to mammals but travel easily in water where they may be toxic to fish and aquatic organisms; and fungicides, which vary greatly in their toxicity. *Id.*

191. WILLIAM H. RODGERS, ENVIRONMENTAL LAW 407 (West, 2d ed. 1994). Narrow-spectrum pesticides are those that only affect a small group of organisms, where as broad-spectrum pesticides are those that affect a wide range of organisms.

192. *Id.* at 407-08.

193. *Id.*

194. *Id.* The reasons for the relatively short life span of pesticides include the tendency for pests to develop resistance to pesticides, rendering the pesticides obsolete for that pest, and the fact that FIFRA allows for "me-too" registration, which tends to reduce the market share of the original pesticide. A me-too registration allows a pesticide manufacturer, in lieu of developing its own data to support registration, to rely on data generated by a previous registrant provided the me-too applicant makes an offer to compensate the previous registrant for the use of the data. 7 U.S.C. § 136a(c)(1)(F)(iii) (2000).

adopt research and development strategies that favor broad-spectrum pesticides with broad market opportunities in order to get the biggest bang for the buck during the limited life span of a pesticide.¹⁹⁵

In the past ten years, the biotechnology sector of the pesticide industry has undergone tremendous growth. Naturally-existing microbes have been genetically modified to make them toxic to insects and other pests.¹⁹⁶ In addition, agricultural crop plants themselves have been genetically modified to produce substances that have pesticidal effects.¹⁹⁷ These pesticidal living organisms pose novel ecological risks by virtue of their ability to reproduce and spread in the environment.

B. *Ecological Risks of Pesticides*

Scientists estimate that as many as ten million species, or 99 percent of the earth's wild biodiversity, not including cultivated and weedy species are in a "precarious condition."¹⁹⁸ Causes and contributors to the decline of so many species include indirect habitat destruction through clearing for agriculture and development, the spread of non-native invasive species, pollution, over-harvesting of species, and disease.¹⁹⁹ Although direct habitat destruction is undoubtedly the leading contributor of species loss (estimated as being implicated in 85 percent of U.S. species decline), pollution, including pesticide pollution, is implicated in 24 percent of U.S. species decline.²⁰⁰ Pesticide poisoning of fish and wildlife is a significant factor in species decline.²⁰¹

195. RODGERS, *supra* note 191, at 407-09.

196. See Microbial Pesticides; Experimental Use Permits and Notifications, 58 Fed. Reg. 5,878 (Proposed Jan. 22, 1993).

197. See Regulations Under the Federal Insecticide, Fungicide, and Rodenticide Act for Plant-Incorporated Protectants, 66 Fed. Reg. 37,772 (July 19, 2001) (codified at 40 C.F.R. pts. 152, 174).

198. Edward O. Wilson, *forward* to DAVID S. WILCOVE, *THE CONDOR'S SHADOW*, *supra* note 121, at xiv.

199. *Id.*

200. WILCOVE, *supra* note 121, at 8.

201. Moreover, the spread of non-native species is implicated in 49 percent of U.S. species decline. In one study of the decline of fish species in the United States, Canada and Mexico, it was determined that the destruction of physical habitat was implicated in 73 percent of the decline, the displacement by introduced species was implicated in 68 percent of the decline, the alterations of habitat by chemical pollutants was implicated in 38 percent of the declines, hybridization with other species and subspecies was implicated in 38 percent of the declines, and over harvesting was implicated in 15 percent of the declines. The numbers add up to more than one hundred because more than one factor is implicated in many of the fish population declines. WILSON, *supra* note 33, at 253-54. Thus, while pesticide usage in itself may not directly destroy habitat (although clearing for agriculture certainly does), chemical pesticides may be a significant contributor to species decline, and pesticidal GMOs, which pose risks of spread in the environment similar to non-indigenous species release, may also be important contributors. Habitat destruction, spread of nonnatives, pollution, overkill, and disease have been referred to as the five horsemen of the environmental apocalypse. WILCOVE, *supra* note 121, at 8.

Because pesticides, by definition, are intended to kill or disrupt living organisms and because they are intentionally released into the environment, often in large quantities over large areas, it is not surprising that pesticides pose a wide array of risks to individual species as well as to overall ecosystem function. Many pesticides are broad-spectrum, affecting diverse species, including many nontarget organisms.²⁰² Others are more narrowly targeted to pest species. However, even these narrowly targeted pesticides may have significant impacts on nontarget species closely related to the intended targets.²⁰³ Some pesticides persist in the environment for weeks, months, and even years, while others breakdown relatively quickly.²⁰⁴ Moreover, living organisms vary significantly in their susceptibility to pesticides.²⁰⁵ The potential ecological risks of pesticide use depend on a number of factors, including toxicity or other hazards of the pesticide, method of application, persistence in the environment, amount used, and susceptibility of nontarget organisms.²⁰⁶ Further, not many data are available on the environmental effects of pesticide usage on many species. Accordingly, the ecological risks of pesticides cannot be easily described or quantified. Nevertheless, some generalizations can be made.

Many pesticides in current use in the United States and other parts of the world are highly acutely toxic and are known to cause adverse effects on nontarget mammals, birds, reptiles, amphibians, fish, and invertebrates.²⁰⁷ Birds and other wildlife may be exposed through direct spraying, ingesting pesticide granules, drinking water contaminated by pesticides, or eating prey organisms contaminated by pesticides. While the banning and severe restriction of certain pesticides such as DDT over the past thirty years has dramatically reduced certain risks to wildlife, many risks remain.²⁰⁸ In addition to effects from direct exposure to

202. See RODGERS, *supra* note 191 and accompanying text.

203. See Edwards, *supra* note 173, at 17–24.

204. *Id.* at 17.

205. *Id.* at 18.

206. *Id.*

207. For a detailed discussion of the risks pesticides cause to wildlife species, see Comments on the Proposed Joint Counterpart Endangered Species Act Section 7 Consultation Regulations. Letter from Defenders of Wildlife and twenty-nine other commenters to Gary Frazer, Assistant Director for Endangered Species, U.S. Fish & Wildlife Serv., and Phil Williams, Chief, Endangered Species Div., Nat'l Oceanic and Atmospheric Admin. Fisheries (April 16, 2004) (on file with author).

208. For example, when roughly ten thousand dead birds were tested for the presence of West Nile Virus in 2000, the New York State Department of Environmental Conservation determined that pesticides and other chemicals were actually responsible for more bird kills than the virus. Laura A. Haight, *Local Control of Pesticides in New York: Perspectives and Policy Recommendations*, 9 ALB. L. ENVTL. OUTLOOK 37, 51 (2004). As further evidence of the effects on bird populations, studies have shown substantially higher nesting rates of birds, as well as significantly higher bird abundance and avian species richness, on organic farms compared to conventional farms that use synthetic pesticides. Nancy A. Beecher, Ron J. Johnson, James R.

pesticides, birds and other wildlife may also be exposed to pesticides by ingesting contaminated prey animals.²⁰⁹

Other less visible species are also at considerable risk from pesticide exposure. For example, for the past decade, considerable concern and debate existed in the scientific community over the worldwide decline of amphibians. Significant data now support a conclusion that certain pesticides, such as the herbicide atrazine, may be contributing to the world-wide decline in amphibian populations.²¹⁰

Although the most obvious adverse effects of pesticide use are those on humans and large animals such as mammals and birds, the most significant adverse effects of pesticides are likely to be those on invertebrates, which are closely related to target pest species.²¹¹ Casualties from this “friendly fire” are widespread in the invertebrate world.²¹²

Brandle, Ronald M. Case, & Linda J. Young, *Agroecology of Birds in Organic and Nonorganic Farmland*, 16 CONS. BIOL. 1620 (2002).

209. The New York State Department of Environmental Conservation found that a number of different avian species, such as screech owls, red-tailed hawks, American kestrels, and other raptors, died as a result of eating small rodents that had consumed rat poison. Haight, *supra* note 209, at 51.

210. Haight, *supra* note 208, at 51. For example, in 2002, the organization Californians for Alternatives to Toxics (CATS) filed suit seeking an order requiring the state Department of Pesticide Regulation to reevaluate the state registration of pesticide products containing the active ingredients malathion, chlorpyrifos, diazinon, methidathion, endosulfan, chlorothalonil, and trifluralin. The lawsuit contends that these pesticides may be responsible for significant population declines of several species of amphibians in the Sierra Nevada mountains. Until very recently, many studies on the effects of pesticides on amphibians have been puzzling because pesticide levels in nature tend to be much lower than levels found to be lethal in the laboratory setting. See Rick Relyea, *Predators Make Pesticides More Lethal*, in 5 CONSERVATION IN PRAC., Spring 2004, at 5 (excerpting Rick A. Relyea, *Predator Cues and Pesticides: A Double Dose of Danger for Amphibians*, 13 ECOLOGICAL APPLICATIONS 1515 (2003)). See also Davidson et al., *supra* note 73. A recent study sheds new light on this dilemma. Scientists have determined that the combination of the pesticide carbaryl and stress from the presence of predators was more lethal in certain amphibian species than the pesticide by itself. *Id.* In other words, a synergistic affect appears to be at work between pesticides and predators making the combination of the two more lethal than the sum of the parts and resulting in even low concentrations of pesticides in nature being highly lethal to amphibians. Of course, amphibians in nature must cope with other stress, such as the presence of predators, in addition to the stress of pesticides. Accordingly, this study demonstrates that amphibians in nature may be significantly more sensitive to pesticides than they are in the sterile isolated confines of the research laboratory. *Id.*

211. HUNTER, *supra* note 29, at 156–57.

212. See May Berenbaum, *Friendly Fire*, WINGS: ESSAYS ON INVERTEBRATE CONSERVATION, Spring 2004, 8. For example, the insect Order Lepidoptera contains not only many pest moth species but also contains many non-pest butterfly species. These butterfly species may be beneficial pollinators and may be aesthetically pleasing, colorful, and interesting varieties such as the monarch butterfly. Also, Lepidoptera contains a number of butterfly species listed as threatened or endangered under the federal Endangered Species Act. 50 C.F.R. § 17.11 (2005). Pesticides used to kill pest moth species generally do not discriminate within the Lepidoptera order and will also kill non-pest, beneficial butterflies including endangered species. See HUNTER, *supra* note 29, at 157–58. Mosquito control pesticides have been indicted as one of the threats to the continued survival of the endangered Miami Blue Butterfly over the past few

Perhaps equally if not more important than direct acute effects on nontarget organisms are the chronic effects upon growth, physiology, reproduction, and behavior.²¹³ Much less is known about these chronic effects than is known about acute effects.²¹⁴ Even a pesticide not toxic enough to kill an organism can have very significant sublethal effects on the organism by affecting its life span, growth, physiology, behavior, and reproduction.²¹⁵ Moreover, pesticides have been documented to have significant indirect effects on nontarget organisms by reducing the populations of animals or plants that serve as food or cover for other species.²¹⁶

One of the most insidious risks posed by pesticides is the tendency of certain synthetic pesticides to mimic hormones, such as estrogen, in humans and wildlife. Only recently has science begun to understand these complex effects.²¹⁷ Estrogen-mimicking substances include a number of pesticides as well as a wide variety of other products in common use, such as toiletries, spermicides, and plastics.²¹⁸ Exposure to these compounds, particularly when the exposure occurs to a fetus or young children, has been correlated with a large number of effects in humans including decreased sperm counts, breast and testicular cancer, endometriosis,

decades. Jaret C. Daniels & Thomas C. Emmel, *Florida's Precious Miami Blues*, in WINGS: ESSAYS ON INVERTEBRATE CONSERVATION, Spring 2004, 3. This recent issue of the Xerces Society publication was devoted exclusively to butterfly conservation; four out the five articles listed pesticides as a significant contributor to butterfly population declines. *See id.* Moreover, recent studies demonstrate a reduction in the abundance of nontarget butterflies on conventional farms as compared to butterflies on organic farms. D.J. Hole et al., *Does Organic Farming Benefit Biodiversity?*, 122 BIOLOGICAL CONSERVATION 113 (2004).

213. Edwards, *supra* note 173, at 24.

214. *Id.*

215. *Id.* For example, extreme low doses of some pesticides have been determined to disrupt honeybees' homing flight behavior, thereby adversely affecting pollination. Helen M. Thompson, *Behavioural Effects of Pesticides in Bees—Their Potential for Use in Risk Assessment*, 12 ECOTOXICOLOGY 317 (2003).

216. Edwards, *supra* note 173, at 28–29.

217. Although the term "environmental estrogen" was coined in the 1970s, not until the past fifteen years were any scientific studies conducted to support the hypothesis that environmental exposure to certain synthetic chemicals could cause estrogenic effects. For a detailed discussion of the risks of endocrine disrupting chemicals and the legal shortcomings in addressing such risks, see generally Noah Sachs, *Blocked Pathways: Potential Legal Responses to Endocrine Disrupting Chemicals*, 24 Colum. J. Envtl. L. 289 (1999). *See also* THEO COLBURN ET AL., OUR STOLEN FUTURE: ARE WE THREATENING OUR FERTILITY, INTELLIGENCE AND SURVIVAL? A SCIENTIFIC DETECTIVE STORY (1997); Matthew P. Longnecker et al., *The Human Health Effects of DDT (Dichlorodiphenyltrichloroethane)*

and PCBs (Polychlorinated Biphenyls) and an Overview of Organochlorines in Public Health, 18 REV. OF PUB. HEALTH 211 (1997); Louis J. Guillette et al., *Developmental Abnormalities of the Gonad and Abnormal Sex Hormone Concentration in Juvenile Alligators from Contaminated and Control Lakes in Florida*, 8 ENVTL. HEALTH PERSP. 680 (1994); David Crews et al., *Endocrine Disruptors: Present Issues, Future Directions*, 75 Q. REV. OF BIOLOGY 243 (2000).

218. Sachs, *supra* note 217, at 302–07.

deformed or stunted reproductive organs, neurological defects, and low birth weights.²¹⁹ In addition to causing these human health effects, these substances have also been implicated in numerous wildlife harms including deformed alligators and reproductive difficulty in birds, fish, and mammals.²²⁰ These estrogenic effects can be extremely complex, unpredictable, and difficult to understand.²²¹

Another concern with the ecological risks of pesticides is the uncertainty regarding the effects of pesticides on ecologically significant microorganisms. Very little is known about the complex ecology of microorganisms.²²² Although few studies have been conducted to evaluate whether most types of pesticides pose significant risks to microorganisms, soil fumigants, designed to destroy soil microorganisms and applied at very high doses, may pose substantial risks to beneficial microorganisms.²²³ For example, the killing of soil microbes and invertebrates resulting from pesticide use may actually cause crops to become more susceptible to disease and may thereby reduce crop growth. In addition, populations of nitrogen-fixing organisms may be reduced, thereby requiring higher levels of fertilizer application.²²⁴ Critical ecological services provided by microorganisms, including decomposition, may also be affected by certain pesticides.²²⁵

219. *Id.* at 293–98.

220. *Id.*

221. *Id.* at 300. For example, DDT exposure has caused female gulls to begin sharing nests with other females rather than males and young gulls to have grossly feminized reproductive tracts. See Susan M. Salvatore, *Estrogens in the Environment*, 69 FLA. B.J. 39, n. 35 (1995). Moreover, a large number of studies on various species of fish exposed to estrogenic compounds have shown effects such as increased time to maturity, smaller gonads, and reduced fertility. *Id.* at n. 36. Similarly, declines in the reproductive rates of mammals, such as minks, has been linked to ingesting fish contaminated with estrogenic substances. *Id.* at n. 37. The U.S. Fish and Wildlife Service has reported that between 1985 and 1990, 67 percent of male Florida panthers were born with one or more undescended testes, compared with only 14 percent ten years earlier. *Id.* at n. 38. Although the phenomenon is not fully understood, scientists suspect a link with exposure to estrogenic substances in the environment. Perhaps the most widely cited examples of endocrine dysfunction in wildlife are the feminization of alligators and occurrence of masculinized female fish in Florida. Interestingly, although the estrogenic effects of certain pesticides are only beginning to be understood, in her 1962 book, *Silent Spring*, Rachel Carson predicted such effects:

A substance that is not a carcinogen in the ordinary sense may disturb the normal functioning of some part of the body in such a way that malignancy results. Important examples are the cancers, especially of the reproductive system, that appear to be linked with disturbances of the balance of sex hormones . . . [t]he chlorinated hydrocarbons are precisely the kind of agent that can bring about this kind of indirect carcinogenesis.

CARSON, *supra* note 1, at 235.

222. Edwards, *supra* note 173, at 18.

223. *Id.*

224. *Id.* at 31.

225. David Pimentel et al., *Assessment of Environmental and Economic Impacts of Pesticide Use*, in THE PESTICIDE QUESTION, *supra* note 62, 47, 68–69.

The ecological risk from pesticide exposure is exacerbated by the tendency of certain pesticides to undergo a phenomenon known as bioaccumulation. Bioaccumulation of pesticides became widely recognized during the 1960s as a result of Rachel Carson's book, *Silent Spring*. Carson explained how DDT and other organochlorine pesticides can persist in the environment for years if not decades and can also accumulate in the tissue of animals and humans.²²⁶ These pesticides accumulate in animals on the bottom of the food chain and then pass from prey to predator, eventually resulting in very high concentrations in top predators, a phenomenon known as biomagnification. Pesticides that persist, accumulate, and biomagnify are especially insidious in that they can adversely affect organisms far removed in both time and space from the original release of the pesticide into the environment.²²⁷

Moreover, although agricultural systems are not natural systems per se, they are generally in close proximity to natural ecosystems and often contain within their borders sizable natural and semi-natural ecosystems.²²⁸ Thus, pesticide usage in agricultural systems may negatively affect ecosystems within the farm boundaries as well as contaminating nearby ecosystems by pesticide runoff in water, drift through the air, or movement of contaminated organisms.

As described above, loss of invertebrate nontarget species may be the greatest risk from pesticide use. Loss of invertebrate biodiversity, however, is not the only concern. Equally concerning is the ecological and economic disruptions that frequently occur as a result of nontarget predators and parasites being killed by pesticides. Many pest populations are naturally kept in check by organisms that feed on pest species. Consequently, if these predators or parasites are eliminated or greatly reduced in number, the populations of pest species will explode. In addition to existing pest species population increases resulting from pesticide usage, new pest species may be created.²²⁹

In the past ten years, a completely new suite of risk concerns have emerged regarding the use of pesticidal genetically modified organisms

226. CARSON, *supra* note 1, at 21–23.

227. HUNTER, *supra* note 29, at 156. Other risks posed by pesticides have only recently begun to be studied. For example, in recent years the extent of atmospheric transport of pesticides has come to light. Edwards, *supra* note 173, at 32–33. Moreover, the pesticide methyl bromide has been determined to be a significant contributor to the thinning of the stratospheric ozone layer. See Protection of Stratospheric Ozone: Process for Exempting Critical Uses from the Phaseout of Methyl Bromide, 69 Fed. Reg. 76,982 (Dec. 23, 2004) (to be codified at 40 C.F.R. pt. 82).

228. HUNTER, *supra* note 29, at 276.

229. *Id.* at 277. An example of new pest creation resulting from pesticide use is the bollworm, which is now a major economic pest of cotton. HUNTER, *supra* note 29, at 158. Although the bollworm existed previously, it was not a pest until pesticides used to control the boll weevil, another pest of cotton, killed the natural enemies of the bollworm, allowing its population to explode. *Id.*

(GMOs). Although many of the risk considerations for biotechnology pesticides are similar to those of traditional chemical pesticides, these new pesticides pose a number of novel risks. One of the most significant novel risk considerations for pesticidal GMOs is the potential for spread of the living organism or the organism's genetic material. For example, plants can reproduce sexually and/or asexually and, as a result, the genetic material introduced into the plant enabling the plant to produce pesticidal substances could spread through agricultural or natural ecosystems. Thus, if a plant that produces a pesticide can spread in the environment or can spread its genetic material to other plants, a greater potential would exist for exposure to nontarget organisms than would be for a pesticide produced in a plant that can only grow in a limited geographic area or does not have the ability to cross-fertilize with other plants.²³⁰ This is a particular concern for pesticides produced in plants that have wild relatives in the United States.²³¹ If these wild relatives acquire the ability to produce the pesticide through cross-fertilization, many additional nontarget organisms could be exposed to the pesticide.²³² One of the most cited concerns regarding pesticidal GMOs is the potential for development of "superweeds" through the outcrossing²³³ of pesticidal GMOs to wild relatives.²³⁴ Development of such a superweed has the potential to substantially disrupt agricultural and natural ecosystems.²³⁵

230. For a detailed discussion of the potential risks and benefits of pesticidal GMOS, see Mary Jane Angelo, *Genetically Engineered Plant Pesticides: Recent Developments in the EPA's Regulation of Biotechnology*, 7 U. FLA. J.L. & PUB. POL'Y 257 (1996).

231. *Id.* at 287.

232. The potential for a GMO or its genetic material to spread from one plant to another raises additional risk issues beyond those of exposure to humans and non-target organisms. One potential risk of biotechnology products parallels the risk of the introduction of any non-native species into a new environment. David J. Earp, Comment, *The Regulation of Genetically Engineered Plants: Is Peter Rabbit Safe in Mr. McGregor's Transgenic Vegetable Patch?*, 24 ENVTL. L. 1633, 1666-69 (1994). Even very small genetic manipulations can significantly change an organism's ability to survive and flourish in a particular ecosystem. *Id.* Examples abound regarding the disastrous but unpredicted effects of introducing non-native species into the environment, displacing native species. See Judy J. Kim, *Out of the Lab and Into the Field: Harmonization of Deliberate Release Regulations for Genetically Modified Organisms*, 16 FORDHAM INTL. L.J. 1160 (1993). Introducing GMOs into the environment could have similar impacts. See Earp at 1653. One of the most significant risks is the risk of a genetically engineered plant becoming a weed or pest itself or outcrossing to related species to create new weeds or pests. *Id.* at 1654-55. Once released into the environment, the spread of a GMO may be extremely difficult, if not impossible, to control. *Id.*

233. Outcrossing is where one variety or species of a plant pollinates another species or variety to form a hybrid of the two.

234. For example, the ability to produce a pesticide that makes a plant resistant to insect or viral pests can be spread to a wild relative and subsequently passed on to the relative's subsequent generations. Consequently, the wild relative, by virtue of its newly acquired ability to resist insects or viruses, has the potential to become a hardy weed, or superweed.

235. For a GMO plant to transfer its genes to related existing weed species, wild relatives of the GMO plant must grow in the geographic areas where the GMO plant is introduced. See Earp, *supra* note 232, at 1666-69. Most crops grown in the United States are of foreign origin.

Perhaps the most serious concern with pesticidal GMOs stems from the uncertainty of the risks of GMOs. Moreover, although the risk of GMO release creating a new superweed or disrupting the balance of natural ecosystems may be small, the consequences could be disastrous and irreversible.²³⁶ The precise nature and magnitude of the risk is difficult to predict because of the almost infinite variety of potential GMOs, the ability of GMOs to reproduce and spread, the complexity inherent in natural ecosystems, and the dearth of long-term data on the effects of GMOs.²³⁷

Thus, the risk of hybridization between transgenic crops and wild relatives is unlikely in the United States. Most of the major U.S. crops, including soybeans, corn, and wheat, have been bred to the point where they have lost their ability to compete with wild species in the environment. Thus, these crops are unlikely to become weeds when genetically altered. *Id.* at 1654. Nevertheless, once these GMOs are exported (intentionally or otherwise) to other parts of the world that have wild relatives of the GMOs, the risks become more profound. Although beyond the scope of this Article, the risks posed by GMOs to human health, particularly by exposure through foods that have been genetically modified are a significant concern. Another issue that has received considerable attention is the potential for plant-incorporated protectants in foods to pose a risk of human allergenicity. The primary concern appears to be that if a gene that leads to the production of a pesticide is moved from one plant to another plant, for example from a peanut to corn, people who know they are allergic to peanuts will not know to avoid the corn plant. Thus, if the pesticide derived from the peanut plant contains an allergen from the peanut plant, allergic consumers could be put at risk. *See generally* Judith E. Beach, *No "Killer Tomatoes": Easing Federal Regulation of Genetically Engineered Plants*, 53 FOOD DRUG L.J. 181, 187 (1998). In addition, the movement of genes from animals to plants may concern subpopulations of people with special dietary preferences such as vegetarians or persons who observe kosher (Jewish) or halal (Muslim) laws. D. Douglas Hopkinset al., *Envtl. Def. Fund, A MUTABLE FEAST: ASSURING FOOD SAFETY IN THE ERA OF GENETIC ENGINEERING* 45 (1991), http://www.environmentaldefense.org/documents/2612_MutableFeast.pdf. Finally, GMO herbicide-tolerant plants may result in increased herbicide usage. Recently, studies show a reduction in biodiversity in the vicinity of some genetically modified herbicide-tolerant crops due to increased herbicide use causing a decrease in weeds and other plants that produce seeds, for insects, birds, and other species. L.G. Firbank et al., *THE IMPLICATIONS OF SPRING-SOWN GENETICALLY MODIFIED HERBICIDE TOLERANT CROPS FOR FARMLAND BIODIVERSITY: A COMMENTARY ON THE FARM SCALE EVALUATIONS OF SPRING SOWN CROPS* (2003), <http://www.defra.gov.uk/environment/gm/fse/results/fse-commentary.pdf>.

236. *See* John Charles Kunich, *Mother Frankenstein, Doctor Nature, and the Environmental Law of Genetic Engineering*, 74 S. CAL. L. REV. 807, 818 (2001).

237. *See* Steen, *supra* note 235, at 764. This discussion of the risks of GMOs is not intended to suggest that these pesticides have no benefits. In fact, many scientists believe that GMO pesticides may provide a less risky alternative to chemical pesticides. Many GMOs are less toxic than chemical GMOs, more narrowly targeted towards the intended pest, and released into the environment in smaller quantities. Nevertheless, the purpose of this discussion on the unique ecological risks posed by GMO pesticides is merely to highlight the complex ecological risks at issue and the large amount of uncertainty regarding such risks. It is worth noting that although no catastrophic damage has been caused by GMOs in the marketplace for the past several years, the pesticidal GMOs commercialized to date are largely innocuous from an ecological standpoint. All of the commercialized products to date include genes from bacteria and viruses non-toxic to humans and naturally ubiquitous in the environment and have been applied widely to food crops in their microorganism form for decades. For example, the *B.t.* delta-endotoxin produced by numerous plant-incorporated protectants in wide use is essentially the same *B.t.* toxin that occurs naturally in soil and is ubiquitous in the environment. However, thousands of GM products in the research and development stage are not so innocuous or well understood.

C. *History of Ecological Issues in Pesticide Regulation*

First introduced in the 1930s and eventually banned in the early 1970s, the pesticide DDT starkly illustrates the meteoric rise of a pesticide based on significant economic and human health benefits and the subsequent dramatic fall based on severe ecological and human health risks. Starting in 1939 and continuing through World War II, the U.S. military used DDT extensively to control insect vectors of deadly diseases such as typhus.²³⁸ DDT is credited with saving millions of lives from such diseases during the war.²³⁹ By 1945, DDT had become a favorite agricultural pesticide, used in most of the world to control a variety of agricultural pests as well as biting insects such as mosquitoes.²⁴⁰ At its peak in the 1950s an estimated six thousand tons of DDT were released annually into the environment in the United States alone.²⁴¹ Rachel Carson's 1962 book *Silent Spring* first brought to the public's attention the downside of the seemingly miracle pesticide. In her book, Carson raised a number of significant ecological concerns regarding the widespread use of DDT including the killing of beneficial as well as pest insects, the disruption of the natural ecological balance, and the bioaccumulation of the pesticide in the food chain resulting in risks to aquatic organisms, avian species, and humans.²⁴² Carson's book led to a public outcry against the threats of DDT and other persistent pesticides. After establishing a link between DDT and the dramatic decline of numerous bird species, including the American Bald Eagle, a movement developed to ban the use of DDT. Images of avian egg-shell thinning, deformed birds, and other ecological effects caused by DDT and its relatives fueled the public's new concerns over environmental issues and played a significant role in developing the environmental movement of the 1960s and early 1970s. In 1969, the U.S. Department of Agriculture, the agency in charge of pesticide registration at the time,²⁴³ cancelled certain uses of DDT and initiated an intensive review of other uses.²⁴⁴ Shortly after its creation, EPA began a formal review under FIFRA of the remaining uses of DDT. In 1972 EPA issued the final order canceling

Research is being done on just about every genetically modified product that human ingenuity can conceive, including corn plants that produce a spider silk that can be used to make bulletproof jackets and soy plants that produce a scorpion toxin. These new products must be approached with much greater caution.

238. Morriss & Meiners, *supra* note 184, at 7.

239. *Id.*

240. Stevens Indus., Inc., 1 E.A.D. 9 (June 2, 1972) (Consolidated DDT Hearings).

241. *Id.*

242. See generally CARSON, *supra* note 1.

243. Prior to the creation of EPA in 1970, the U.S. Department of Agriculture was responsible for administering FIFRA. In 1970, these responsibilities were transferred to EPA. Reorganization Plan No. 3, 84 Stat. 2086 (1970).

244. See Stevens Indus., Inc., 1 E.A.D. 9 (June 2, 1972) (Consolidated DDT Hearings).

the registration for most uses of the pesticide DDT.²⁴⁵ In the final order, EPA concluded that the long-range risks of continued use of DDT were unacceptable and outweighed any economic or societal benefits it provided.²⁴⁶

The DDT controversy, which gained attention through the publication of *Silent Spring*, became one of the primary motivators behind the 1970 establishment of EPA. The controversy also paved the way for a 1972 major overhaul of FIFRA, which had been on the books in a somewhat less ambitious form for over sixty years. The origin of FIFRA traces back to the federal Insecticide Act of 1910.²⁴⁷ The 1910 Act was a consumer protection statute addressing concerns with false claims about the effectiveness of many pesticide products that turned out to be useless and the converse problem of pesticides that were too strong and thus caused crop damage.²⁴⁸ This consumer protection emphasis carried over into the first enactment of FIFRA in 1947. The 1947 Act contained the first registration requirement for pesticides (referred to by the Act as "economic poisons").²⁴⁹ The 1947 Act, however, did not establish significant safety standards for pesticides. A pesticide could be registered if the composition of the pesticide warranted the proposed claims for it and if the pesticide and its labeling complied with the FIFRA requirements.²⁵⁰ The 1947 Act remained intact until 1972. The 1972 amendments to FIFRA completely overhauled the statute and for the first time included provisions aimed at protecting environmental interests. The 1972 amendments form the backbone of the current FIFRA.

Despite the focus on ecological risks that dominated the DDT controversy and paved the way for the 1972 overhaul of FIFRA, ecological concerns played a much more modest role in the implementation of FIFRA during the 1980s and 1990s. In fact, during that period EPA brought only a handful of cancellation or suspension actions based primarily on wildlife or other ecological risks. The only reported judicial or administrative case in which regulatory action was based primarily on risks to wildlife was *Ciba-Geigy v. EPA*²⁵¹ in which EPA proposed canceling certain uses of diazinon on golf courses and turf due

245. *Id.*

246. *Id.*

247. Insecticide Act of 1910, Pub. L. No. 61-152, 36 Stat. 331 (1910), *repealed by* Federal Insecticide, Fungicide, and Rodenticide Act, Pub. L. No. 80-104, 61 Stat. 163, 172 (1947).

248. RODGERS, *supra* note 191, at 412-13.

249. Federal Insecticide, Fungicide, and Rodenticide Act, ch. 125, Pub. L. No. 80-104, 61 Stat. 163, 172 (1947).

250. *Id.*

251. 874 F.2d 277 (5th Cir. 1989).

in large part to the risk to wild birds.²⁵² In addition to the diazinon case, EPA considered canceling certain uses of pesticides based on risks to wildlife during the 1980s and 1990s. However, EPA failed to take any significant action to address such risks.²⁵³

In the past few years, there have been a number of controversies over the adverse impacts to wildlife species, including threatened and

252. *Id.* at 278. This case involved the effects on birds of the use of diazinon on golf courses and turf. *Id.* Specifically, the case addressed the question of whether FIFRA requires a precise determination of risk or harm (e.g. the chemical has adverse effects 51 percent of the time it is used) in order to support cancellation of a registration. *Id.* at 279. Another related point of contention was whether a devastating effect on bird populations or merely a significant adverse effect will justify cancellation. *Id.* at 279–80. In this case, the chemical company's contentions, that there should be more exact thresholds and more significant effects on the overall bird population, were rejected by the court. *Id.* at 280. The Fifth Circuit held that FIFRA gives the Administrator sufficient discretion to conclude that recurring bird kills are an unreasonable adverse environmental effect regardless of whether they significantly reduce bird populations. *Id.* Ultimately, the case was remanded to the Administrator to rectify the former administrator's failure to read the word "generally" as meaning "usually," "commonly," or "with considerable frequency." The phrase "generally causes unreasonable adverse effects on the environment" is also read to include any *potential* general causation of adverse effects. *Id.* at 279–80.

Further, despite suffering a stinging defeat in 1989 at the hands of environmental groups claiming that EPA's continued registration of the pesticide strychnine was a violation of the federal Endangered Species Act, EPA continued to register, and allow the continued registration of, pesticides that pose risks to threatened and endangered species. *Defenders of Wildlife v. EPA*, 882 F.2d 1294 (8th Cir. 1989). In *Defenders*, the court found that EPA's continued registration of the pesticide strychnine constituted a taking under section 9 of the Endangered Species Act, even though there was no evidence as to the chain of possession of the strychnine or other links between EPA's registration of the pesticide and the ultimate death of the listed species. *Id.* at 1301. The court held, in essence, that EPA's decision to allow the registration to remain in effect, rather than suspending or canceling the registration, subjected the agency to section 9 liability. *Id.* In concluding that "EPA's decision to register pesticides containing strychnine or to continue those registrations was critical to the resulting poisoning" of the endangered species, the court clearly was influenced by the fact that the pesticide could not legally be sold or distributed except under an EPA registration. *Id.*

253. For example, in 1991, EPA proposed the cancellation of the pesticide ethyl parathion due to risks to both humans and wildlife from the high acute toxicity of this pesticide. After negotiating with the manufacturers of ethyl parathion, however, EPA accepted a settlement which involved the cancellation of only the ground application uses of the pesticide, which posed significant risks to human farm workers, but did not include the cancellation of aerial application, which posed the greatest risks to birds and other wildlife due to spray drift associated with this form of application. See Notice, 56 Fed. Reg. 65,061–01 (Dec. 13, 1991); Notice of Issuance of Amended Cancellation Order, 57 Fed. Reg. 3,500–01 (Jan. 29, 1992); Notice of Issuance of Corrections of Amended Cancellation Order, 57 Fed. Reg. 6,168–01 (Feb. 20, 1992). In fact, ethyl parathion had been implicated in the deaths of thousands of birds. Nevertheless, EPA declined to take regulatory action to prevent or minimize these risks. 56 Fed. Reg. 65,061 (Dec. 13, 1991). Ultimately, the remaining uses of ethyl parathion were voluntarily cancelled in 2001 after a concerted campaign led by the American Bird Conservancy in partnership with Defenders of Wildlife, the Pesticide Action Network, and the World Wildlife Fund to pressure EPA and the manufacturer of the pesticide to end all uses. Ethyl Parathion: Notice of Use Cancellation, 66 Fed. Reg. 47,667–01 (Sept. 13, 2001). However, despite the fact that ethyl parathion was considered to be one of the most toxic pesticides in current use and had been documented to cause thousands of bird kills, and despite decades of study by EPA, the agency itself failed to take regulatory action to protect wildlife.

endangered species, from pesticides. One such controversy started in 2002 when forty environmental groups, including the American Bird Conservancy and Defenders of Wildlife, sent EPA a Notice of Intent to Sue for Violations of the Endangered Species Act, Migratory Bird Treaty Act, and Administrative Procedures Act Concerning the Registration of the Pesticide Fenthion due to the high risks the pesticide posed to avian species. Later that year, the U.S. Fish and Wildlife Service recommended that EPA immediately cancel existing registrations for fenthion due to its unreasonable adverse effects to avian species protection under the Endangered Species Act (ESA)²⁵⁴ and the Migratory Bird Treaty Act (MBTA).²⁵⁵ When EPA did not take action to reduce the risks from fenthion, in October 2002 Defenders of Wildlife, the American Bird Conservancy, and the Florida Wildlife Federation filed suit against EPA in federal district court alleging EPA had violated the ESA and MBTA. In 2003 the manufacturer of fenthion voluntarily canceled its registration of fenthion.

In addition, in September 2004 environmentalists won a significant victory when the Ninth Circuit affirmed a district court's 2004 order that found that EPA had violated the ESA because it had failed to take steps to ensure that the registration of fifty-four pesticides would not jeopardize the survival of listed salmon species.²⁵⁶ The court of appeals upheld the district court's injunction, which imposed detailed buffer zones restricting the use of more than thirty pesticides along listed salmon-supporting waters in California, Oregon, and Washington states.²⁵⁷

As these recent cases illustrate, EPA has been reluctant to take regulatory action to prevent registration of, or cancel the registration of, a pesticide that poses significant ecological risks. In fact, EPA has failed to take such actions even when challenged by environmental organizations. Instead, such challenges have led manufacturers to voluntarily cancel their registrations, as in the case of fenthion, rather than EPA taking

254. 16 U.S.C. §§ 1531–1544 (2000).

255. *Id.* §§ 703–711.

256. *See* Wash. Toxics Coalition v. EPA, No. C01–013132C (W.D. Wash. Jan. 22, 2004), available at <http://www.epa.gov/espp/wtc/index.html>. This order was the third in a series of orders granting injunctive relief to the environmental plaintiffs in this matter. *See also* Wash. Toxics Coalition v. EPA, No. C01–013132C (W.D. Wash. July 16, 2003), available at <http://www.epa.gov/espp/wtc/index.html>; Wash. Toxics Coalition v. EPA, No. C01–013132C (W.D. Wash. Aug. 8, 2003), available at <http://www.epa.gov/espp/wtc/index.html>.

257. *Id.* On September 1, 2005, CropLife America filed a Petition for Writ of Certiorari to have the case reviewed by the U.S. Supreme Court. Another case alleging that the EPA violated the ESA by registering six pesticides without reviewing the negative effects on the Barton Springs Salamander, a listed species, settled when EPA agreed to a schedule to analyze the effects of the pesticides on the salamander. *Ctr. for Biological Diversity v. Johnson*, No. 1:04–cv–00126–CKK, Settlement Agreement (D.C. Cir. 2005), available at http://www.epa.gov/oppead1/cb/csb_page/updates/bartonsprings-agreemt.pdf.

action to reduce ecological risks. EPA's reluctance to take action to address purely ecological concerns of pesticide use illustrates the broader problem that much of environmental protection law is focused predominantly on human health issues, with ecological concerns receiving little or no attention.

It should not be considered a bold statement to assert that environmental protection law is intended to protect the environment, yet it is. As the illustrations above show, implementation of FIFRA seems largely to have ignored any such intent. If environmental protection is the goal, it would be logical to expect environmental protection law to be guided by the science of ecology, the study of the interactions of living organisms and their environments. However, after more than thirty years of significant public concern over environmental protection and more than thirty years of implementation of numerous environmental protection laws, it is surprising how little these laws have been used to address environmental concerns, and how little ecological science has informed environmental law. Typically, environmental concerns are addressed only where there is a sufficient, independent, human health-related motivation. Moreover, many of the first-generation environmental laws developed ad hoc in reaction to the particular environmental crisis of the moment.²⁵⁸ This collection of piece-meal laws have not kept pace with the science's ever-increasing understanding of ecological systems.²⁵⁹

In recent years, there have been greater attempts to incorporate ecological principles into environmental law and policy decisions. Professor Dan Tarlock has argued that environmental law derives its legitimacy from science.²⁶⁰ Toxicology, engineering, and other sciences have certainly played a significant role in environmental law. The role of the ecological sciences, however, has been much more modest. Although the science of ecology has informed certain areas of environmental law, such as endangered species protection,²⁶¹ most pollution-focused laws have not incorporated ecological principles in any significant way.

258. See BROOKS ET AL., *supra* note 28, at 26-29.

259. For a proposal to create a single umbrella environmental statute, see Lakshman Guruswamy, *Integrating Thoughtways: Re-Opening of the Environmental Mind?* 1989 WISC. L. REV. 463 (1989).

260. Tarlock, *supra* note 33, at 1122. Tarlock explains how science not only has been used to identify environmental harms, but also to develop ways to remedy such harms. Tarlock argues that science remains the primary justification for environmental protection policy. Without a scientific foundation, Tarlock states, "environmentalism would be the marginal aesthetic movement that it was between the progressive conservation era and the late 1960s." *Id.* at 1136-37. But see Holly Doremus, *Listing Decisions Under the Endangered Species Act: Why Better Science Isn't Always Better Policy*, 75 WASH. U. L.Q. 1029, 1034 (arguing that science alone cannot solve difficult environmental policy problems).

261. See Tarlock, *supra* note 33, at 1125 (describing how environmental law draws on three disciplines: economics, engineering, and ecology).

Indeed, if ecological sciences have significantly informed any area of environmental law, it is in natural resource management, endangered species protection, and wetlands protection rather than the myriad of so-called pollution control laws that form the complex regulatory web of environmental regulation. The manner in which EPA has implemented the classic pollution control law—the Clean Water Act (CWA),²⁶² the Clean Air Act (CAA),²⁶³ the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),²⁶⁴ and the Resource Conservation and Recovery Act (RCRA)²⁶⁵—tends to be highly focused on protection of human health and tends to treat protection of the environment as almost an afterthought.²⁶⁶ Of course human health protection is of primary concern to most people, and few would place the value of protecting a bird, let alone an insect, above protecting human life. Nevertheless, it should not be forgotten that these environmental protection laws were intended to protect both human health and the environment and that environmental concerns not related to human health provided the impetus for the development of these regulatory programs. Even the bulk of scholarly literature in environmental law has failed to adequately grapple with ecological concerns.²⁶⁷ In addition to the higher priority that human health concerns assume, the limited attempts to protect the environment probably stem, at least in part, from the fact that despite years of study, the ecological sciences have barely scraped

262. 33 U.S.C. §§ 1251–1387 (2000).

263. 42 U.S.C. §§ 7401–7671q (2000).

264. *Id.* §§ 9601–9675.

265. *Id.* §§ 6901–6992k.

266. Robert L. Fischman, *Biological Diversity and Environmental Protection: Authorities to Reduce Risk*, 22 ENVTL. L. 435, 441 (1992) (stating that while virtually every statute that EPA is responsible for implementing contains language that would enable EPA to address ecological concerns in its regulatory programs, EPA has failed to utilize these broad authorities to address ecological concerns). A few of the many examples of EPA's broad authority to address ecological risks include: 33 U.S.C. § 1314(a)(1) (2000) (directing EPA to develop water quality criteria that accurately reflect the latest scientific knowledge on the effect on the health and welfare, including but not limited to the effects on including plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, esthetics, and recreation, as well as on the concentration and dispersal of pollutants or their byproducts through biological, physical, and chemical processes and on biological community diversity); 42 U.S.C. § 9605(a)(8)(A) (2000) (EPA's national contingency plan for hazardous discharge clean-up that must take into account the potential for the destruction of sensitive ecosystems). The Clean Air Act requires EPA to promulgate secondary national ambient air quality standards to protect the public welfare. The statute defines the term "welfare" to include the effects of pollution on soils, water, vegetation, animals, wildlife, and the climate. *Id.* § 7409(a)(1)(B). For a more comprehensive discussion of EPA's statutory authority to consider ecological concerns in its regulatory programs, see generally Fischman *supra*.

267. Both Professors J.B. Ruhl and Lisa Heinzerling have criticized the scholarly discourse on environmental law as being too focused on human health concerns and not focused enough on the important goals of protecting natural systems. Lisa Heinzerling, *Reductionist Regulatory Reform*, 8 FORDHAM ENVTL. L.J. 459, 461 (1997); Ruhl, *supra* note 11, at 541.

the surface of understanding the complex machinery of the natural world. What little is known teaches us that ecological systems are extremely complex and ever-changing.²⁶⁸ Accordingly, it is difficult to design regulatory programs to protect what we do not fully understand and what can be perceived as a moving target.

III. FIFRA (A LICENSE TO KILL)

Regulation of pesticides in the United States is conducted primarily under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).²⁶⁹ FIFRA requires that all pesticides²⁷⁰ sold or distributed in the United States be registered by EPA.²⁷¹ Generally, a pesticide may be registered only if it will not cause an "unreasonable adverse effect on the environment."²⁷² Accordingly, in determining whether to register a pesticide, EPA engages in a cost/benefit analysis, weighing the costs or risks associated with the use of a pesticide against the economic and social benefits of the pesticide. A pesticide may be registered only if the benefits of the pesticide outweigh the costs resulting from the use of the pesticide.²⁷³ To determine whether or the extent to which FIFRA is eco-pragmatic, i.e., addresses the issues of uncertainty, complexity, and change, a close analysis of FIFRA and its implementation by EPA is warranted.

268. For a comprehensive discussion of the U.S. Supreme Court's understanding and use of ecological principles in its decision-making in environmental cases, see Robert W. Alder, *The Supreme Court and Ecosystems: Environmental Science in Environmental Law*, 27 VT. L. REV. 249 (2003).

269. 7 U.S.C. §§ 136–136y (2000).

270. Under FIFRA, the term "pesticide" means "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. . ." *Id.* § 136(u).

271. *Id.* § 136a(a). This subsection provides:

Except as provided by this subchapter, no person in any State may distribute or sell to any person any pesticide that is not registered under this subchapter. To the extent necessary to prevent unreasonable adverse effects on the environment, the Administrator may by regulation limit the distribution, sale or use in any State of any pesticide that is not registered under this subchapter and that is not the subject of an experimental use permit under section 136c of this title or an emergency exemption under section 136p of this title.

Id.

272. *Id.* § 136a(c)(5). FIFRA provides that the term "environment" includes "water, air, land, and all plants and man and other animals living therein and the interrelationships which exist among these." *Id.* § 136j.

273. Under FIFRA, cost/benefit terminology is used opposite to the way it is used in discussing most environmental regulation. Typically, in a cost/benefit analysis, the regulatory agency compares the costs of regulation (e.g., the cost of installing pollution controls) to the benefits of regulation (e.g., lives saved or cancers avoided). Under FIFRA, however, the costs are considered to be the costs of allowing the use of the pesticide (e.g. cancer deaths), whereas the benefits are considered to be the benefits of allowing the use of the pesticide (e.g., reduction in crop loss from pest insect damage).

A. Registration and Other Approval Mechanisms

FIFRA section 3(a) provides that the administrator shall register a pesticide if the administrator determines that, when considered with any restrictions imposed, its composition warrants the proposed claims for it, its labeling and other submitted materials comply with the requirements of FIFRA, it performs its intended function without unreasonable adverse effects on the environment, and when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse affects on the environment.²⁷⁴ As defined by FIFRA, unreasonable adverse affects on the environment are any unreasonable risks to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide.²⁷⁵ Accordingly, when determining whether to register a pesticide, EPA must consider not only any risks the pesticide poses to man or the environment, but also the economic and social implications of using the pesticide. Noticeably, however, while Congress did direct EPA to take into account economic factors in defining unreasonable adverse effect on the environment, it did not explicitly mandate that EPA conduct a strict cost/benefit analysis.²⁷⁶ In fact, the legislative history of FIFRA suggests that adverse affects were not intended to be tolerated in absence of "overriding benefits" from the use of the pesticide.²⁷⁷ Nevertheless, for more than thirty years EPA has interpreted FIFRA to require a cost/benefit balancing, and this interpretation has been upheld by courts.²⁷⁸

274. *Id.* §136a(c)(5) provides:

The Administrator shall register a pesticide if the Administrator determines that, when considered with any restrictions imposed under subsection (d) of this section—

- (A) its composition is such as to warrant the proposed claims for it;
- (B) its labeling and other material required to be submitted comply with the requirements of this subchapter;
- (C) it will perform its intended function without unreasonable adverse effects on the environment; and
- (D) when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse affects on the environment.

275. Section 136(bb) defines the term "unreasonable adverse effects on the environment" as any "unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide. . . ." *Id.* § 136(bb).

276. SHAPIRO & GLICKSMAN, *supra* note 11, at 32, 39.

277. See RODGERS, *supra* note 191, at 451-53.

278. *Env'tl. Def. Fund, Inc. v. EPA* (heptachlor-chlordane), 548 F.2d 998, 1004 (D.C. Cir. 1976), *cert. denied*, 431 U.S. 925 (1977); *In re Chapman Chem. Co.*, FIFRA Dockets No. 246, 1 E.A.D. 199, 203 (EPA 1976) (stating that "before any pesticide can be cancelled under the FIFRA [EPA] must be persuaded that the risks to man or the environment from continued use of the pesticide outweigh the benefits of its continued use."); *In re Protexall Prod., Inc.*, FIFRA

Significantly, although one prong of the test for registration requires EPA to determine the pesticide “will perform its intended function” without unreasonable adverse effects on the environment,²⁷⁹ FIFRA expressly states that EPA shall not make any lack of essentiality a criterion for denying registration of any pesticide and that, where two pesticides meet the requirements for registration, one should not be registered in preference to the other.²⁸⁰ Thus, to obtain a registration, there is no requirement to demonstrate that a pesticide is essential. Moreover, the availability of alternative pesticides for the same use does not preclude registration. Further, FIFRA expressly authorizes EPA to waive all data requirements pertaining to efficacy and EPA has, by rule, done so.²⁸¹

One of the most important requirements is that the registrant submit data in support of registration.²⁸² FIFRA gives EPA discretionary

Docket No. 625, 2 E.A.D. 854 (EPA 1989) (stating that “the risk-benefit assessment...involves a balancing of the risks . . . against the benefits”).

279. *Id.* § 136a(c)(5)(C).

280. *Id.* § 136a(c)(5) provides that:

The Administrator shall not make any lack of essentiality a criterion for denying registration of any pesticide. Where two pesticides meet the requirements of this paragraph, one should not be registered in preference to the other. In considering an application for the registration of a pesticide, the Administrator may waive data requirements pertaining to efficacy, in which event the Administrator may register the pesticide without determining that the pesticide’s composition is such as to warrant proposed claims of efficacy.

281. 40 C.F.R. § 158.640(b)(1) (2005). The burden of providing EPA with the necessary information to determine whether the standard for registration is met rests at all times with the registrant or applicant for registration. The procedures for registering pesticides are set forth in the statute and regulations. *See, e.g.*, 40 C.F.R. Pt. 152 (2005).

282. 7 U.S.C. § 136a(a) (2000) provides:

Except as provided by this subchapter, no person in any State may distribute or sell to any person any pesticide that is not registered under this subchapter. To the extent necessary to prevent unreasonable adverse effects on the environment, the Administrator may by regulation limit the distribution, sale or use in any State of any pesticide that is not registered under this subchapter and that is not the subject of an experimental use permit under section 136c of this title or an emergency exemption under section 136p of this title.

Id. § 136a(c)(2) provides:

The Administrator shall publish guidelines specifying the kinds of information which will be required to support the registration of a pesticide and shall revise such guidelines from time to time. . . . In the development of these standards, the Administrator shall consider the economic factors of potential national volume of use, extent of distribution, and the impact of the cost of meeting the requirements on the incentives for any potential registrant to undertake the development of the required data. . . .

Data requirements are found at 40 C.F.R. Part 158 and provide for the submission of health and environmental effects data. The applicant for registration must bear the cost of gathering and generating the necessary data. To avoid duplicative data generation, the statute encourages joint development of data and provides that applicants seeking to reach agreement on the terms of a data development arrangement may seek binding arbitration. *Id.* §

authority to register products in certain situations even though not all data necessary to make a decision on registration have been generated. This is called "conditional registration." Conditional registration can be used for products with composition and proposed uses identical or substantially similar to currently registered pesticides, products with proposed new uses, or certain products with a new active ingredient.²⁸³ For the first two categories, EPA must determine that despite the lacking data, approval of the conditional registration would not significantly increase the risk of any unreasonable adverse effects on the environment.²⁸⁴ For new active ingredients, EPA must determine that the use of the pesticide during the period of conditional registration will not cause unreasonable adverse effects on the environment and use of the pesticide is in the public interest.²⁸⁵

Most environmental risk reduction measures under FIFRA are achieved through labeling restrictions. An applicant for registration must submit all proposed labeling with the registration application.²⁸⁶ A FIFRA "label" is the written, printed, or graphic matter on or attached to the pesticide.²⁸⁷ The term "labeling" under FIFRA includes the label as well as all other written, printed, or graphic matter that accompanies the

136a(c)(1)(F)(iii). Data already submitted to the agency to support an existing registration may be relied upon to support a new registration application provided the applicant for the new registration offers to pay compensation to the registrant who originally submitted the data. Data submitted to support a registration the first time a particular active ingredient is registered are protected by the "exclusive use" provisions of FIFRA and cannot be considered by EPA to support additional registrations for a period of ten years. *Id.* In addition, FIFRA 7 U.S.C. 136h generally governs the disclosure of information submitted to EPA pursuant to FIFRA requirements. 7 U.S.C. 136h(d) provides that health and safety data must be made available to the public, except that 7 U.S.C. 136h(g) prohibits disclosure of health and safety data to multinational pesticide producers except during public proceedings under law or regulation. 7 U.S.C. 136h(b) and (d) provide that other confidential business information ordinarily may not be released and provide specific protection for the formula and information on inert ingredients. Exemptions from these confidentiality protections are provided to avoid imminent public health risks and when the Administrator determines that disclosure is in the public interest during a proceeding to determine whether a pesticide causes unreasonable adverse effects. Any such release of information is subject to procedural protections involving prior notice and opportunity for district court review.

283. *Id.* § 136a(c)(7), registration under special circumstances, provides:

Notwithstanding the provisions of paragraph (5)–

(A) The Administrator may conditionally register or amend the registration of a pesticide if the administrator determines that (i) the pesticide and proposed use are identical or substantially similar to any currently registered pesticide and use thereof, or differ only in ways that would not significantly increase the risk of unreasonable adverse effects on the environment, and (ii) approving the registration or amendment in the manner proposed by the applicant would not significantly increase the risk of any unreasonable adverse effect on the environment.

284. *Id.* § 136a(c)(7)(A).

285. *Id.*

286. *Id.* § 136a(c)(1)(C).

287. *Id.* § 136(p)(1).

pesticide or to which reference is made on the label.²⁸⁸ All registered products must bear a label or labeling setting forth precautionary statements, warnings, directions for use of the product, and an ingredient statement. A product whose label or labeling does not contain the information required by EPA or which sets forth false or misleading information is misbranded.²⁸⁹ FIFRA requires users of pesticides to follow all label directions.²⁹⁰ The requirement for users to follow label instructions is the only obligation FIFRA imposes on users of pesticides. Thus, the label is the only mechanism to regulate user behavior to accomplish risk reduction goals.

Under section 3(d)(1), a pesticide may be classified for either general or restricted use.²⁹¹ A restricted use pesticide may be used only by or under the supervision of a certified applicator and is not available for purchase by the general public.²⁹² A pesticide classified for restricted use would cause unreasonable adverse effects on the environment absent such a restriction.²⁹³ Certification of applicators is primarily a state function. State certification plans must conform to certain standards enumerated in the statute.²⁹⁴

FIFRA provides for several forms of pesticide approval in addition to registration under section 3. First, EPA may grant an emergency exemption under FIFRA section 18.²⁹⁵ Section 18 provides that the Administrator has discretion to exempt any federal or state agency from any provision (normally, the registration requirement) of the Act if emergency conditions require such an exemption.²⁹⁶ An emergency condition means an urgent, non-routine situation and is deemed to exist

288. *Id.* § 136(p)(2).

289. *Id.* §§ 136(q) and 136j(a)(1)(E).

290. *Id.* § 136j(a)(2)(G) provides that it shall be unlawful for any person to use any registered pesticide in a manner inconsistent with its labeling.

291. *Id.* § 136a(d)(1).

292. *Id.*

293. *Id.*

294. *Id.* § 136i, regarding the use of restricted use pesticides, provides:

Use of restricted use pesticides; applicators

(A) certification procedure

(1) Federal certification

In any State for which a State plan for applicator certification has not been approved by the Administrator, the Administrator, in consultation with the Governor of such State, shall conduct a program for the certification of applicators of pesticides. . . .

(2) State certification

If any State, at any time, desires to certify applicators of pesticides, the Governor of such State shall submit a State Plan for such purpose. The Administrator shall approve the plan submitted by any State [meets certain general conditions regarding the state's legal authority, funding mechanisms, etc.].

295. *Id.* § 136p.

296. *Id.*

when: no effective pesticides are available under the Act that have labeled uses registered for control of the pest under the conditions of the emergency; no economically or environmentally feasible alternative practices which provide adequate control are available; and the situation involves the introduction or dissemination of a new pest, will present significant health risks, will present significant environmental risks, or will cause significant economic loss.²⁹⁷

In addition to federal pesticide registration under FIFRA, states may issue registrations of pesticide products or uses of such products to meet special local needs under FIFRA section 24(c).²⁹⁸ A section 24(c) registration may be issued to: 1) allow use of a new formulation of a federally registered pesticide; 2) amend federal registration to permit use on additional crops or pests or at additional sites, or to permit use of different application techniques, rates, and equipment; 3) amend federal registration with special label directions necessary to prevent adverse effects or to ensure efficacy under local conditions; or 4) for any other purposes consistent with FIFRA. Valid state registrations are treated as federal registrations under FIFRA.²⁹⁹

FIFRA section 5 authorizes EPA to issue Experimental Use Permits (EUPs) for field testing of unregistered pesticides.³⁰⁰ The Administrator may issue an EUP if she determines that the applicant needs such a permit to accumulate information necessary to register a pesticide under section 3 of FIFRA.³⁰¹ Finally, Section 3(a) authorizes EPA, to the extent necessary to prevent unreasonable adverse effects on the environment, to issue regulations limiting the distribution, sale, or use of any pesticide that is not registered under the Act and that is not subject to an EUP under section 5 or an emergency exemption under section 18.³⁰²

B. Continuing Duties of Registrants

Once a pesticide is registered, registrants face a number of continuing responsibilities, particularly with regard to supplying additional data. In 1978, Congress added a provision to FIFRA, section 3(c)(2)(B), giving EPA the authority to require holders of existing registrations to provide data to support the continued registration of a pesticide.³⁰³ Section 3(c)(2)(B) allows the Agency at any time to require additional data to support an existing registration. The penalty for failure

297. *Id.*

298. *Id.* § 136v(c)(1).

299. *Id.*

300. *Id.* § 136c.

301. *Id.* § 136c(a).

302. *Id.* § 136a(a).

303. *Id.* § 136a(c)(2)(B).

to supply this data is suspension of the registration, which results in a prohibition on sale and distribution of the product.³⁰⁴ Prior to suspension under section 3(c)(2)(B), a registrant has a right to a limited adjudicatory hearing. The only issues to be considered at such a hearing are whether “the registrant has failed to take the action” which is the basis of the suspension and whether the disposition of existing stocks is consistent with the Act.³⁰⁵

In addition to information required to be submitted under section 3(c)(2)(B), registrants are under a continuing obligation under FIFRA section 6(a)(2) to submit factual information regarding unreasonable adverse effects on the environment of the pesticide whenever the registrant has such information.³⁰⁶ EPA has adopted a rule which describes specifically the types of information that must be reported and the time frame for submission of these reports.³⁰⁷

The 1972 revisions to FIFRA included a tougher standard for initial registration of pesticides and mandated that the Agency reexamine previously registered pesticides.³⁰⁸ This reexamination or “reregistration” reflects a congressional determination that previously-registered pesticides ought to be as “safe” as newer ones and a recognition that the data EPA had for these older pesticides were not as complete or up-to-date as that for newer pesticides. Reregistration has proved to be one of the most critical and one of the most difficult regulatory tasks for EPA’s pesticide program.³⁰⁹ Because reregistration efforts were moving so slowly, in 1988 Congress enacted a new section 4 of FIFRA that prescribes specific reregistration requirements intended to dramatically

304. *Id.* § 136a(c)(2)(B)(iii).

305. *Id.* § 136a(c)(2)(B)(iv).

306. *Id.* § 136d(a)(2).

307. 40 C.F.R. Pt. 159 (2005). In addition to authority to require information reporting, EPA has broad enforcement authority, which it shares with the states under FIFRA. EPA generally is responsible for manufacturer/producer enforcement, while the states have primary responsibility for user enforcement. The manufacturer/producer enforcement provisions give the Agency authority to register pesticide establishments, to inspect and to take samples, to inspect books and records, and to issue “stop sale, use or removal” orders and to institute seizure actions. 7 U.S.C. §§ 136e-g, k (2000). Pursuant to section 27 of FIFRA, a state must have adequate pesticide laws and regulations and must be implementing such laws and regulations in order to maintain primary enforcement responsibility for pesticide use situations. *Id.* § 136v. The Agency can respond to an emergency requiring immediate action if a state is unwilling or unable to respond. *Id.* § 136w-1. Under section 16(c), the Agency is authorized to seek an injunction against violations of the Act in federal district court. *Id.* § 136n(c). A person who violates any provision of the Act may be subject to civil penalties under section 14(a). *Id.* § 136l. The amount of the penalty is determined by a consideration of the appropriateness of the penalty to the size of the business, the effect on the violator’s ability to stay in business, and the gravity of the violation. *Id.* § 136l(a)(4). Moreover, a person who knowingly violates any provision of the Act may be subject to criminal penalties which carry larger fines and the possibility of a prison sentences. *Id.* § 136l(b).

308. *Id.* § 136a-1.

309. RODGERS, *supra* note 191, at 431.

change both the pace and the nature of reregistration.³¹⁰ The 1988 amendments require EPA to complete, over a nine-year period, the reregistration review of each registered product containing any active ingredient initially registered before November 1, 1984.³¹¹ The amendments redirected the initial burden of identifying data gaps from EPA to the affected registrants. Moreover, the amendment establishes a multi-phased process with a number of deadlines that ensures that reregistration moves at a more accelerated pace. Failure of registrants to meet the prescribed deadlines may result in suspension or cancellation of registration.³¹²

C. Cancellation and Suspension

EPA may cancel or suspend existing registrations based upon certain risk/benefit determinations. FIFRA section 6(b), which specifically addresses cancellation, states that EPA may issue a notice of intent to cancel if a pesticide or its labeling does not comply with FIFRA or if, when used in accordance with widespread and commonly recognized practice, the pesticide generally causes unreasonable adverse effects on the environment.³¹³ Under section 6(b) there are two types of cancellation actions: section 6(b)(1)—notice of intent to cancel or change classification; and section 6(b)(2)—notice of intent to hold a hearing to determine whether registration should be cancelled or classification changed.³¹⁴ For both sections 6(b)(1) and 6(b)(2), EPA must make a

310. 7 U.S.C. § 136a-1.

311. *Id.*

312. *Id.*

313. *Id.* § 136d(b). FIFRA requires review of the proposed cancellation notice by the Secretary of Agriculture (USDA) and the FIFRA Scientific Advisory Panel (SAP). The statute dictates that the notice must be submitted to USDA and the SAP sixty days prior to notification of the registrant or publication, whichever comes first. If USDA and the SAP do not submit comments within thirty days, EPA may publish the notice. If USDA and the SAP do submit comments, EPA may, after reviewing such comments, withdraw the notice, issue a final notice without modification, or modify the notice, as appropriate. Once the notice is published, persons adversely affected have thirty days to request a hearing. If no such hearing is requested, the notice of intent to cancel becomes final. If a hearing is requested, the hearing is considered a formal adjudicatory proceeding and is held before an administrative law judge (ALJ). Such a proceeding is governed by the Agency's rules at 40 C.F.R. Part 164.

314. *Id.* § 136d(b).

Administrative review, suspension

(b) Cancellation and change in Classification

If it appears to the Administrator that a pesticide or its labeling . . . does not comply with the provisions of this subchapter or, when used in accordance with widespread and commonly recognized practice, generally causes unreasonable adverse effects on the environment, the Administrator may issue a notice of the Administrator's intent either-

finding that the risks appear to outweigh the benefits. For section 6(b)(2), however, a hearing may be held when the Administrator's judgment concerning the risks and benefits of a pesticide is only tentative.³¹⁵ Before taking final action under section 6(b), the Administrator must determine whether any unreasonable risks posed by a pesticide's use can be sufficiently reduced by regulatory measures short of cancellation. Such measures include imposition of additional labeling restrictions and/or classification of the pesticide for restricted use. If the Administrator determines that adequate risk reduction cannot be achieved by such regulatory measures, the registration of the pesticide for that use must be cancelled. An EPA Final Order on a cancellation is reviewable in district court.³¹⁶

FIFRA also authorizes EPA to suspend the registration of a pesticide based on certain findings. FIFRA provides for two types of suspension proceedings—"ordinary" and "emergency" suspension.³¹⁷

(1) to cancel its registration or to change its classification together with the reasons (including the factual basis) for the Administrator's action, or

(2) to hold a hearing to determine whether or not its registration should be canceled or its classification changed.

... In determining whether to issue any such notice, the Administrator shall include among those factors to be taken into account the impact of the action proposed in such notice on production and prices of agricultural commodities, retail food prices, and otherwise on the agricultural economy. At least 60 days prior to sending such notice to the registrant or making public such notice, whichever occurs first, the Administrator shall provide the Secretary of Agriculture with a copy of such notice and an analysis of such impact on the agricultural economy.

... The proposed action shall become final and effective at the end of 30 days from receipt by the registrant, or publication, of a notice . . . , unless within that time either (i) the registrant makes the necessary corrections, if possible, or (ii) a request for a hearing is made by a person adversely affected by the notice. . . . In taking any final action under this subsection, the Administrator shall consider restricting a pesticide's use or uses as an alternative to cancellation and shall fully explain the reasons for these restrictions, and shall include among those factors to be taken into account the impact of such final action on production and prices of agricultural commodities, retail food prices, and otherwise on the agricultural economy.

Id. § 136d(b).

315. There is no distinction between section 136d(b)(1) and section 136d(b)(2) hearings in the manner of conduct, burden of proof, or nature of initial decision by ALJ. One issue generally considered as part of the cancellation process is whether the agency should allow the continued sale and use of existing stocks of the pesticide.

316. Of the more than sixty pesticide cancellations and suspensions, only approximately one third have been judicially reviewed. RODGERS, *supra* note 191, at 480. EPA's refusal to initiate proceedings to cancel or suspend a registration is considered a final order reviewable in district court. *See* *Env'tl. Def. Fund v. EPA*, 465 F.2d 528 (D.C. Cir. 1972).

317. 7 U.S.C. §136d(c) (2000) Suspension

(1) Order

If the Administrator determines that action is necessary to prevent an imminent hazard during the time required for cancellation or change in classification proceedings, the Administrator may, by order, suspend the registration of the

Ordinary suspension is issued where such action is necessary to prevent an imminent hazard during the time required for cancellation proceeding. "Imminent hazard" is defined as a substantial likelihood of serious harm during the duration of cancellation proceedings.³¹⁸ The term is not limited to a concept of crisis. The function of a suspension action is to assess the evidence required to determine the risks and benefits for the period involved, not an ultimate resolution of the cancellation issues.³¹⁹ In an ordinary suspension, notification to the registrant of the intent to suspend and an opportunity for a hearing is required prior to effectiveness of suspension. Only a registrant may request an adjudicatory hearing. The order becomes effective either after a favorable decision following a hearing, or five days after notification if no hearing is requested.³²⁰ If no hearing is requested, the suspension order is not reviewable by a court.³²¹ If a hearing is requested, an expedited administrative adjudicatory hearing is held before an administrative law judge (ALJ) in which

pesticide immediately. Except as provided in paragraph (3) no order of suspension may be issued under this subsection unless the Administrator has issued or at the same time issues, a notice of intention to cancel; the registration, or change the classification of the pesticide under subsection (b) of this section. Except as provided in paragraph (3), the Administrator shall notify the registrant prior to issuing any suspension order. Such notice shall include findings pertaining to the question of "imminent hazard." The registrant shall then have an opportunity . . . for an expedited hearing before the Administrator in the question of whether an imminent hazard exists.

(2) Expedited hearing

If no request for a hearing is submitted to the Administrator within five days of the registrant's receipt of the notification . . . , the suspension order may be issued and shall take effect and shall not be reviewable by a court. If a hearing is requested, it shall commence within five days of the receipt of the request for such hearing unless the registrant and the Administrator agree that it shall commence at a later time.

(3) Emergency order

Whenever the Administrator determines that an emergency exists that does not permit the Administrator to hold a hearing before suspending, the Administrator may issue a suspension order in advance of notice to the Registrant. The Administrator may issue an emergency order under this paragraph before issuing a notice of intention to cancel the registration or change the classification of the pesticide under subsection (b) . . . In the case of an emergency order, paragraph (2) shall apply except that (A) the order of suspension shall be in effect pending the expeditious completion of the remedies provided by that paragraph and the issuance of the final order on suspension, and (B) no party other than the registrant and the Administrator shall participate except that any person adversely affected may file briefs within the time allotted by the Agency's rules.

318. *Id.* § 136(l).

319. *Id.* § 136d(c)(1).

320. *Id.* § 136d(c)(2).

321. *Id.*

interested persons can intervene. The sole issue at the hearing is whether an imminent hazard exists.³²²

An emergency suspension order, which is effective immediately, may be issued if an emergency exists that does not permit even an expedited hearing before suspension takes place.³²³ Registrants have five days to request an expedited hearing and the hearing must begin within five days of the Agency's receipt of such a hearing request.³²⁴ If an expedited hearing is requested, the emergency order remains in effect until the issuance of a final suspension order following the hearing.³²⁵ No party other than the registrant and the Agency may participate in the expedited hearing except for the filing of briefs.³²⁶ An emergency suspension order is subject to immediate review in district court.³²⁷

D. Enter GMOs

Pesticidal GMOs are regulated under FIFRA in much the same way as are traditional chemical pesticides.³²⁸ For pesticidal GMOs, this means

322. *Id.*

323. *Id.* § 136d(c)(3).

324. *Id.*

325. *Id.*

326. *Id.*

327. *Id.* § 136d(c)(4).

Section 17(b) provides:

(b) Cancellation Notices Furnished to Foreign Governments. — Whenever a registration, or cancellation or suspension of the registration of a pesticide becomes effective, or ceases to be effective, the Administrator shall transmit through the State Department notification thereof to the governments of other countries and to appropriate international agencies. Such notification shall, upon request, include all information related to the cancellation or suspension of the registration of the pesticide and information concerning other pesticides that are registered under section 136a of this Act and that could be used in lieu of such pesticide.

Id. § 136o(b).

328. The decision to treat GMOs similarly to traditional pesticides is rooted in the early U.S. biotechnology policies of the 1980s. The U.S. Government's first systematic attempt to address the regulation of biotechnology in a comprehensive fashion was with the publication of the 1984 document entitled "Proposal for a Coordinated Framework for Regulation of Biotechnology." 49 Fed. Reg. 50,856 (Dec. 31, 1984). The purpose of this document was "to provide a concise index to U.S. laws related to biotechnology, to clarify the policies of the major regulatory agencies that will be involved in reviewing research and products of biotechnology, to describe a scientific advisory mechanisms for assessment of biotechnology issues, and to explain how the activities of the Federal agencies in biotechnology will be coordinated." *Id.* In 1986, the Office of Science and Technology Policy (OSTP) published in the Federal Register "Coordinated Framework for Regulation of Biotechnology: Announcement of Policy; Notice for Public Comment" ("the coordinated framework"). 51 Fed. Reg. 23,302 (June 26, 1986). This approach was based on a belief that rDNA technology in itself does not create risk. See Celeste Marie Steen, Note, *FIFRA's Preemption of Common Law Tort Actions Involving Genetically Engineered Pesticides*, 38 ARIZ. L.R. 763, 766 (1996). Instead, certain types of products of biotechnology may pose risks that can be addressed in the same fashion as regulatory agencies address the risks posed by traditional chemical products. During the 1980s and early 1990s, the

using FIFRA to regulate the "pesticide" rather than targeting regulation at the process by which the pesticide is created.³²⁹ GMOs that are intended to kill, disrupt, repel, or mitigate pests are regulated in much the same way as traditional chemical pesticides under FIFRA. As described above, section 2(u) of FIFRA defines the term "pesticide" as: "(1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, and (2) any substance or mixture of substances intended for use as a plant regulator, defoliator, or desiccant." This definition is very broad and can include living organisms and substances produced by living organisms as well as traditional chemical pesticides. The definition of "pesticide" in FIFRA does not depend on the process by which a particular pesticide is produced. EPA has interpreted this definition to include biological pesticides and genetically modified pesticides. Thus, pesticidal GMOs must be registered under FIFRA prior to sale or distribution in the United States. The standard for registration is the same for pesticidal GMOs as they are for traditional chemicals. EPA has developed some data requirements specifically geared to address potential risks from microbial pesticides, including microbial GMOs.³³⁰

One category of pesticidal GMOs regulated by EPA under FIFRA includes microbial GMOs. EPA has regulated naturally-occurring microbial pesticides, such as *B.t.*, for many years. Microbial pesticides are

executive branch of the U.S. Government was focused on promoting biotechnology as the United States' hope for strong economic future. The feeling at the time was that the United States had allowed Japan to beat it in the electronics industry. The federal government was determined not to allow this to happen with the biotech industry. The message was clear that regulatory agencies were not to stand in the way of biotechnology. There would not be any new biotechnology legislation, and agencies would continue to rely on existing regulatory programs. For pesticidal GMOs, this meant FIFRA. Moreover, a raging debate ensued over whether regulatory agencies should be regulating the "process" of genetic engineering or the "products" of genetic engineering. At that time, it was determined that, from a risk standpoint, the process was irrelevant and that agencies should regulate only products of biotechnology. Under the coordinated framework, the regulatory approach taken by U.S. regulatory agencies, including EPA, has been to rely on existing statutes and to focus on the "product" rather than the "process" used to create the product. *Id.*

329. EPA's primary authority for regulating agricultural biotechnology products can be found in two statutes: FIFRA, 7 U.S.C. §§ 136-136y (2000), and FFDCA, 21 U.S.C. §§ 301-392 (2000). Under FIFRA, EPA has the authority to address all environmental and human health issues associated with pesticide use. Under FFDCA, EPA has the authority to set tolerances for pesticide residues in or on food. EPA also regulates biologicals and biotechnology products that are not pesticides, food, or drugs under the Toxic Substances Control Act (TSCA), 15 U.S.C. §§ 2601-2692 (2000). TSCA grants EPA the authority to screen new chemical substances and impose controls to prevent unreasonable risks and, through rulemaking, to acquire information and impose restrictions to prevent unreasonable risks on existing chemical substances. Although some agricultural biotechnology products may fall within the purview of TSCA, the majority of agricultural biotechnology products regulated by EPA are considered pesticides under EPA's broad definition of the term and, thus, are regulated under FIFRA and FFDCA.

330. The data requirement for microbial pesticides can be found at 40 C.F.R. § 158.740 (2005).

regulated in much the same way as traditional pesticides at the large-scale testing and registration stages. EPA has expressed concern about the potential for adverse effects associated with small-scale environmental testing of certain microbial pesticides, both naturally-occurring and genetically engineered. Small-scale testing of most traditional pesticides is generally considered to pose very limited risks and, thus, typically is not regulated by EPA. Because microbial pesticides are living organisms that have the potential to reproduce and spread in the environment, however, even small-scale testing can present unreasonable adverse effects on the environment.³³¹ Thus, EPA has promulgated a rule that requires notification prior to any small-scale testing of certain microbial pesticides, including microbial GMOs.³³²

Another category of pesticidal GMOs regulated by EPA under FIFRA are pesticidal genetically modified plants, or "plant-incorporated protectants."³³³ In July 2001, EPA published its long-awaited rule for the regulation of plant-incorporated protectants under FIFRA.³³⁴ The plant-incorporated protectant rule took approximately ten years to develop. Countless public hearings, scientific advisory council meetings, congressional hearings, and interagency negotiations were held.³³⁵ Despite all of these efforts, however, the resultant rule is quite modest and does not really tackle the complex and novel risks of GMOs. The thrust of the new rule merely defines the scope of what types of pesticidal GMOs EPA believes warrant regulation.³³⁶ EPA has identified several

331. See Microbial Pesticides; Experimental Use Permits and Notifications, Final Rule, 59 Fed. Reg. 45,600 (1994) (codified at 40 C.F.R. pt. 172).

332. 40 C.F.R. § 172 (2005).

333. A plant-incorporated protectant is defined as a pesticidal substance that is intended to be produced in a living plant, or in the produce thereof, and the genetic material necessary for its production. 40 C.F.R. § 152.3 (2005).

334. Regulations Under the Federal Insecticide, Fungicide, and Rodenticide Act for Plant-Incorporated Protectants (Formerly Plant-Pesticides), 66 Fed. Reg. 37,772 (July 19, 2001) (codified at 40 C.F.R. pts. 152, 174). EPA does not yet have any rules governing GM animals. For an historical discussion of the Plant-Incorporated Protectant Rule, see Angelo, *supra* note 230.

335. Regulations Under the Federal Insecticide, Fungicide, and Rodenticide Act for Plant-Incorporated Protectants (Formerly Plant-Pesticides), 66 Fed. Reg. 37,772 (July 19, 2001) (codified at 40 C.F.R. pts. 152, 174).

336. Under EPA's definition of plant-incorporated protectants, all substances produced by plants and intended for a pesticidal purpose are within EPA's jurisdiction, regardless of whether the plant is genetically modified. However, not all plant-incorporated protectants within EPA's jurisdiction warrant regulation under FIFRA. EPA believes that many plant-incorporated protectants do not warrant any regulation under FIFRA because they pose low probability of risk and will not cause unreasonable adverse effects on the environment. For example, in 1982 EPA promulgated a regulation under FIFRA section 25(b) that exempted all biological control agents from the requirements of FIFRA, except for certain microorganisms. 40 C.F.R. §152.20(a)(3) (2005). This exemption was promulgated because EPA found that macroorganisms used as biological control agents were adequately regulated by other federal agencies, such as the U.S. Department of Agriculture.

categories that it has exempted from any FIFRA regulation because they are low risk.³³⁷ One such category is GMOs that closely resemble the types of plants that could be created naturally or through traditional plant breeding. An example of this would be introducing a substance normally produced by one variety of corn into another variety of corn as opposed to introducing a substance normally produced only in bacteria into corn. This type of plant-incorporated protectant would be exempt because it is not posing any new risks that would not have evolved naturally or through traditional breeding.³³⁸ If a pesticidal GMO does not meet one of these exemptions, however, the regulatory process is virtually identical to the regulatory process for all pesticides—namely, registration based on a cost/benefit analysis and labeling restrictions on use.³³⁹ EPA has not yet established specific data requirements for genetically modified plants that act as pesticides.³⁴⁰

337. EPA's first attempt to describe its plans to regulate plant-incorporated protectants was in early 1994. On January 21, 1994, EPA held a joint meeting of a sub-panel of the Agency's Scientific Advisory Panel and the Biotechnology Science Advisory Committee to address certain scientific issues related to the regulation of pesticidal substances produced in plants. For the meeting, EPA made available to the public a draft proposal of a comprehensive policy and four draft proposed rules, together referred to as the "draft proposal," developed under FIFRA and FFDCA. On November 23, 1994, EPA published in the Federal Register somewhat modified versions of these draft documents (hereinafter together "the proposal"). 59 Fed. Reg. 60,496 (Nov. 23, 1994); Plant-Pesticides Subject to the Federal Insecticide, Fungicide, and Rodenticide Act; Proposed Rule, 59 Fed. Reg. 60,519 (Nov. 23, 1994); Plant-Pesticides Subject to the Federal Insecticide, Fungicide, and Rodenticide Act; Proposed Rule, Plant-Pesticides; Proposed Exemption From the Requirement of a Tolerance Under the Federal Food, Drug, and Cosmetic Act, 59 Fed. Reg. 60,535 (Nov. 23, 1994); Plant-Pesticides; Proposed Exemption From the Requirement of a Tolerance Under the Federal Food, Drug, and Cosmetic Act for Nucleic Acids Produced in Plants, 59 Fed. Reg. 60,542 (Nov. 23, 1994); and Plant-Pesticides; Proposed Exemption From the Requirement of a Tolerance Under the Federal Food, Drug, and Cosmetic Act for Viral Coat Proteins Produced in

Plants, 59 Fed. Reg. 60,545 (Nov. 23, 1994). The proposal was intended to clarify the status of plant-incorporated protectants (referred to as "plant-pesticides" in the 1994 proposal) under FIFRA and FFDCA and outline the scope of what types of plant-incorporated protectants EPA believed warranted regulation based on risk/benefit considerations. Under the proposal, many plant-incorporated protectants would not be subject to regulation because they pose a low potential for risk to humans and/or the environment. Others would be subject to regulation but would be regulated somewhat differently than conventional pesticides because of the unique nature of plant-incorporated protectants. The proposal outlined how EPA intended to assess plant-incorporated protectants at different stages of environmental testing and at the sale and distribution stage. The final plant-incorporated protectant rule, promulgated in 2001, adopted some, but not all of the exemptions proposed in 1994.

338. 40 C.F.R. § 174.25 (2005).

339. EPA has not adopted any specific registration, data, or labeling requirements for plant-incorporated protectants. See *generally* Regulations Under the Federal Insecticide, Fungicide, and Rodenticide Act for Plant-Incorporated Protectants (Formerly Plant-Pesticides), 66 Fed. Reg. 37,772 (July 19, 2001).

340. *Id.*

IV. IS FIFRA ECO-PRAGMATIC?

Although the basic regulatory framework of FIFRA dates back to 1972, with some of its provisions, such as the misbranding prohibition, dating back to the early consumer-protection statutes of the early twentieth century, and despite the fact that a statute with the word "rodenticide" in it would hardly be expected to be cutting-edge, FIFRA is surprisingly eco-pragmatic. In fact, somewhat ironically given the state of pesticide regulation today, the earliest applications of FIFRA have threads of eco-pragmatism running through them. Even by today's standards, the 1972 DDT cancellation decision represents a fairly sophisticated ecological analysis focused on: the tendency of DDT and its metabolites to persist in the soil and aquasphere; the tendency of DDT to be readily transported by leaching, erosion, run-off, and volatilization; DDT's fat soluble characteristic, which enables it to collect and concentrate in animal fat tissue; DDT's ability to bioaccumulate as it moves up the food chain; and the fact that, once accumulated, DDT is toxic to animals and humans and inhibits the ability of fish and other wildlife species to regenerate.³⁴¹ EPA did not shy away from tackling the difficult issue of how to take into account the risks that may occur in the future due to the persistent nature of the pesticide. EPA also was not paralyzed by a lack of certainty in data. For example, even though EPA recognized the degree of transportability of DDT was unknown, EPA considered data showing that DDT was found in remote areas of the world and in ocean species, such as whales, as providing enough evidence from which a logical inference could be drawn that DDT is readily transported in the environment.³⁴² Moreover, EPA concluded that persistence and biomagnification in and of themselves were a "cause of concern, given the unknown and possibly forever undeterminable long-range effects of DDT in man and the environment."³⁴³ Thus, even in 1972 EPA recognized the uncertainty surrounding ecological effects data, while at the same time employing a precautionary approach to prevent uncertain, possibly devastating effects that may occur in the long term.

When the group petitioners who opposed cancellation argued that DDT is only one toxic substance in a polluted environment and that therefore, whatever its laboratory effects, it cannot be shown as the causative agent of injury to wildlife, EPA responded that this argument "does not redeem DDT, but only underscores the magnitude of effect that will be necessary for cleaning up the environment."³⁴⁴ Persuaded by evidence showing metabolites of DDT cause eggshell thinning in certain

341. Stevens Indus., Inc., 1 E.A.D. 9 (June 2, 1972) (Consolidated DDT Hearings).

342. *Id.*

343. *Id.*

344. *Id.*

bird species, EPA found it sufficient despite some contradictory evidence that there was "laboratory data and observation data, and in addition, a scientific hypothesis, which might explain the phenomenon."³⁴⁵ EPA further found that no label restrictions could completely prevent effects on nontarget organisms, persistence and transport in the environment, or biomagnification. Accordingly, cancellation was the only available risk-reduction measure.

EPA's analysis of the benefits of DDT in formulating its decision to cancel was also fairly sophisticated and in some ways did a better job of considering benefits than many more recent EPA decisions regarding cancellation or suspension of pesticides. The benefits analysis focused on the availability of alternatives including non-chemical pest management programs and the fact that the crops protected by DDT were not in short supply. EPA found that DDT was not necessary to ensure adequate supply of cotton at a reasonable cost, given that only 38 percent of the cotton-producing acreage at the time was treated by DDT.³⁴⁶ In contrast to many recent EPA decisions, where non-chemical pest control alternatives and emphasis on availability of crops are conspicuously absent, or at least play a very minimal role, in the decision-making process, EPA's 1972 DDT cancellation decision takes a broader look at the cost/benefit analysis rather than merely counting dollars and cents on each side of the equation. In fact, EPA's 1972 DDT cancellation decision has other indicia of an eco-pragmatic approach. For example, in the final order, EPA's statement that "the risk/benefit equation is a dynamic one" foreshadows arguments for flexibility and adaptive management at the center of eco-pragmatic scholarship.

Subsequent to the DDT cancellation, EPA brought a number of cancellation and suspension actions through which the agency's interpretation of the statutory standard—"unreasonable risks to man and the environment"—developed further.³⁴⁷ This series of FIFRA cancellation and suspension cases cemented the interpretation of FIFRA as containing a cost/benefit balancing standard rather than the open-ended balancing standard that, at least arguably, it was intended to have.³⁴⁸ According to the legislative history of FIFRA as described by

345. *Id.*

346. *Id.*

347. *Env'tl. Def. Fund, Inc. v. EPA* (heptachlor-chlordane), 548 F.2d 998, 1003 (D.C. Cir. 1976), *cert. denied*, 431 U.S. 925 (1977); *In re Chapman Chem. Co.*, FIFRA Docket No. 246, 1 E.A.D. 199 (EPA 1976); *In re Protexall Prod., Inc.*, FIFRA Docket No. 625, 2 E.A.D. 854 (E.P.A. 1989).

348. *See, e.g.*, *In re Chapman Chem. Co.*, FIFRA Docket No. 246, 1 E.A.D. 199 (EPA 1976) (canceling certain uses of mercury in pesticides based on a finding that the risks of continued use outweighed the benefits); *In re Protexall Prod., Inc.*, FIFRA Docket No. 625, 2 E.A.D. 854 (EPA 1989) (describing the registrant's burden in challenging a proposed cancellation as requiring a showing that the "benefits of continued use justify the risks").

Professor William Rodgers, the “unreasonable adverse effects” language was intended to create an environmentally stringent standard for registration.³⁴⁹ The Senate Commerce Committee, which created the standard, described it as not tolerating any adverse effects “unless there are overriding benefits from the use of a pesticide.”³⁵⁰ Accordingly, the standard as contemplated by the Senate drafters of the 1972 FIFRA amendments apparently intended that, although economic and social factors should be considered and balanced against environmental risks, the balancing would not be a simple accounting of dollars and cents on each side of the equation, with the pesticide winning the right to registration as long as the scale was tipped, no matter how slightly, in favor of the benefits provided by the pesticide. Instead, the senate drafters appeared to intend that, where environmental risks exist, the analysis would favor registration only where the risks were outweighed by “overriding benefits.” For example, an overriding benefit might be where a particular pesticide is important to fighting a significant public health problem, such as West Nile disease, and where other less risky control alternatives are not available or are too costly.³⁵¹ Other overriding benefits might include situations where a particular pesticide is necessary to maintain a segment of agriculture where nonchemical or less risky alternatives are not available, and when growing the crop without the pesticide would result in severe economic losses or dramatically increased food prices. However, an overriding benefit would not be found in a situation where, if the pesticide were taken off the market, the evidence showed only that chemical companies would lose money or farmers would have to switch to other existing alternative pest control practices which might involve some additional cost. If FIFRA were amended to make clear that only overriding benefits could outweigh significant environmental risks, then potential registrants would face a more stringent standard and pesticides that posed significant risk would not routinely be registered.

Certainly much can be done to mold FIFRA into a more eco-pragmatic law. Nevertheless, eco-pragmatic themes such as adaptive management and an ecological integrity baseline run throughout the

349. RODGERS, *supra* note 191, at 451.

350. *Id.* (quoting S. REP. NO. 92-970 (1972)).

351. The important role pesticides can play in preventing significant public health problems is specifically addressed by FIFRA. The definition of “unreasonable adverse effects on the environment” provides that:

[t]he Administrator shall consider the risks and benefits of public health pesticides separate from the risks and benefits of other pesticides. In weighing and regulatory action concerning a public health pesticide under this subchapter, the Administrator shall weigh any risks of the pesticide against the health risks such as the diseases transmitted by the vector to be controlled by the pesticide.

7 U.S.C. § 136(bb) (2000).

existing statute. The concept of an ecological baseline can be found in a number of places in FIFRA. Specifically, the standard for registration under FIFRA addresses a large array of ecological concerns as well as human health concerns. FIFRA's regulatory standard aims to prevent "unreasonable adverse effects on the environment."³⁵² The word "environment" is defined very broadly by FIFRA to include "water, air, land, and all plants and man and other animals living therein, and the interrelationships which exist among these."³⁵³ Thus, FIFRA not only broadly includes land, water, air, and plant and animal resources within the definition of "environment," but also includes the "interrelationships" among these resources as encompassed within the definition.

Moreover, FIFRA contemplates an ecological baseline in its premarket evaluation. Under FIFRA, registration is required prior to the sale, distribution, or commercialization of any pesticide product. Except for limited circumstances qualifying for an exemption, some level of regulatory review is required prior to the environmental release of any pesticide even if only for experimentation purposes. Unlike some other environmental regulatory programs, such as the Toxic Substance Control Act (TSCA),³⁵⁴ FIFRA imposes a somewhat precautionary approach in that pesticides are, by definition, intended to kill or disrupt living organisms and are presumed to pose unreasonable risks, and, therefore, they cannot be sold or distributed without a pre-market environmental review.³⁵⁵

FIFRA's precautionary approach also manifests in its allocation of the burden of proof. While not expressly stated in the language of FIFRA, pursuant to a series of administrative and judicial decisions, the burden of proof that a pesticide does not pose an unreasonable adverse effect on the environment remains at all times on the proponent of registration or continued registration.³⁵⁶ Thus, a proponent of registration must demonstrate it meets this burden prior to a pesticide being

352. See, e.g., *id.* § 136(l), 136(x), 136(ee)(2).

353. *Id.* § 136(j).

354. 15 U.S.C. §§ 2601-2692 (2000).

355. In contrast, new non-pesticide chemicals entering the marketplace do not require a premarket environmental review under TSCA. *Id.* § 2604. Instead, prior to manufacturing these new non-pesticide chemical substances under TSCA, all that is required is a ninety day notification to EPA. *Id.* § 2604(a). During the premarket notification period, EPA conducts a cursory review of the proposed new chemical, but unless a determination is made that generation of new data is required, EPA typically does not require environmental testing. *Id.* § 2604. If a non-pesticide substance is later found to pose unforeseen risks, EPA can require additional testing or impose regulations to reduce the risk from such a substance. *Id.* §§ 2603, 2606.

356. *Env'tl. Def. Fund, Inc. v. EPA* (heptachlor-chlordane), 548 F.2d 998, 1004 (D.C. Cir. 1976), *cert. denied*, 431 U.S. 925 (1977); *Env'tl. Def. Fund, Inc. v. EPA* (DDT II), 439 F.2d 584, 593 (D.C. Cir. 1971); *Stearns Elec. Paste Co. v. EPA*, 461 F.2d 293, 304 n.32 (7th Cir. 1972).

registered. Further, if EPA proposes cancellation of a pesticide or use of the pesticide, the burden of proof rests on the proponent for continued registration during any cancellation or suspension hearing that may ensue.

With regard to adaptive management, FIFRA also shows surprising signs of being eco-pragmatic. Many of FIFRA's provisions are specifically designed to seek new information, to adapt to new information, or to tailor the level of regulation to the level of certainty of risks based on the sufficiency of available data. For example, FIFRA establishes two different levels of registration—full registration and conditional registration. EPA may conditionally register a pesticide under certain circumstances despite the fact that sufficient data have not been generated to support full registration. As described above, such circumstances may include a new proposed use for a pesticide already registered for another use. In such a situation, sufficient data exist to support the existing use, but additional data may be required to support full registration of the newly proposed use. Under such circumstances, EPA may conditionally register the pesticide for the new use if conditional registration would not significantly increase the risk of any unreasonable adverse effects on the environment. Accordingly, through the conditional registration process, a degree of flexibility is built into FIFRA allowing products to be used in new ways prior to full data generation.³⁵⁷

Other provisions of FIFRA allowing unique circumstances and changing information to be considered include the emergency exemption provisions, the state registration provisions, and the experimental use permit provisions. The emergency exemption provision of section 18 of FIFRA authorizes EPA to grant an emergency exemption to any state or federal agency in emergency conditions—i.e., urgent non-routine conditions for which no economically or environmentally feasible alternative practices that provide adequate control are available.³⁵⁸ Thus, section 18 provides flexibility to adapt to changing circumstances, which could include the outbreak and spread of a new pest or the spread of a public health disease. In such circumstances, EPA is authorized to act quickly to control the problem before the pest or disease vector is widely disseminated and to minimize the harm without waiting for complete data to support registration.³⁵⁹

The state registration provision in section 24(c) authorizes states to issue registration to meet special local needs.³⁶⁰ Accordingly, this

357. Of course, should the new data demonstrate that the new use does not meet the standards for full registration, full registration will not be granted.

358. 7 U.S.C. § 136p (2000).

359. *Id.*

360. *Id.* § 136v(c).

provision allows states to consider local circumstances warranting use of pesticide products—or particular uses of those products—not generally approved under FIFRA for nationwide use. Thus, in a state where a particular pest causes more severe harm than in other states, the cost/benefit analysis for the use of the pesticide in that state may have a different result from the nationwide cost/benefit analysis for that use, and accordingly, a special local needs registration may be granted for that state only. In this way, FIFRA's flexibility allows registrations to be tailored to the special agricultural, environmental, economic, or other needs of a state.

Finally, the experimental use permit provision continued in FIFRA section 5 is another example of the flexibility afforded by FIFRA in tailoring the amount of data necessary to the level of risk resulting from a particular use. FIFRA section 5 authorizes EPA to issue permits for the field testing of pesticides necessary to generate data to support full registration.³⁶¹ Thus, as the risk from exposure to a pesticide increases (i.e., as it moves from lab testing, to small-scale field testing, to full-scale use), progressively greater data requirements attach to ensure that sufficient data are available to make an unreasonable adverse effects determination for each level of use. Similarly, classification of a pesticide as either general or restricted use allows EPA to adapt the amount of regulation required to the risks associated with the particular pesticide. By classifying a pesticide as restricted use, EPA ensures that users of the pesticide will have at least some training and supervision to reduce the risks associated with the use of that pesticide. With regard to taking advantage of new information as it develops—or requiring new information as new testing methodologies become available or new risk scenarios are understood—FIFRA also contains some relatively eco-pragmatic approaches. Because hundreds of pesticides on the market were registered prior to the adoption of current registration data requirements, FIFRA section 4 contains a detailed “reregistration” process designed to ensure that older pesticides are reexamined in light of more stringent regulatory standards and more sophisticated testing methodologies developed since the early registrations of many pesticides.³⁶² The current reregistration provisions include a multi-phased process with multiple deadlines which must be met to avoid suspension or cancellation.³⁶³ This reregistration approach has been an extremely time-consuming, burdensome, and expensive process.³⁶⁴ Future changes to the registration standard, data requirements, or testing methodologies

361. *Id.* § 136c.

362. 7 U.S.C. § 136a-1 (2000).

363. *Id.*

364. *See* Rodgers, *supra* note 191, at 431-35.

warranting another round of reregistration could also be extremely costly in terms of time and resources. Nevertheless, such a process may be the only way to comprehensively address significant changes.

While reregistration is required of all pesticides registered prior to 1984, a number of FIFRA data requirements apply to previously registered pesticides in a more targeted manner. For example, FIFRA section 3(c)(2)(B) authorizes EPA to require holders of existing registrations to provide additional data whenever EPA finds that "additional data are required to maintain in effect an existing registration of a pesticide."³⁶⁵ Under section 6(a)(2) of FIFRA, if at any time after the registration of a pesticide the registrant obtains any factual information regarding unreasonable adverse effects on the environment of the pesticide, the registrant must submit such information to EPA.³⁶⁶ Unreasonable adverse effects information submitted to EPA may lead to EPA: requesting additional data under section 3(c)(2)(B); initiating a cancellation or suspension action; reclassifying a general use pesticide as a restricted use pesticide; or imposing some other form of regulation to ensure that the pesticide will not cause unreasonable adverse effects on the environment. Thus, FIFRA contemplates a process of ongoing evaluations of pesticide risks as new information becomes available. With regard to pesticidal GMOs, EPA has taken the section 6(a)(2) approach a step farther to require ongoing reporting of adverse environmental effects data, not only for registered pesticides, but also for pesticides that qualify for a plant-incorporated protectant exemption.³⁶⁷ In its plant-incorporated protectant rule, EPA requires any person who produces, for sale or distribution, a plant-incorporated protectant exempt under the rule, or who obtains any information regarding adverse effects on human health or the environment alleged to have been caused by the plant-incorporated protectant to submit such information to EPA.³⁶⁸

V. REINVENTING FIFRA THROUGH ECO-PRAGMATISM

Notwithstanding all of these promising elements, FIFRA has not lived up to its eco-pragmatic promise. As described more fully below, a

365. 7 U.S.C. § 136a(c)(2)(B) (2000).

366. *Id.* § 136d(a)(2).

367. 40 C.F.R. § 174.1 (2005).

368. *Id.* § 174.71. This rule goes on to explain that, for the purposes of plant-incorporated protectants:

[A]dverse effects on human health or the environment...means at a minimum information about incidents affecting humans or other nontarget organisms where both: (1) The producer is aware, or has been informed, that a person or nontarget organism allegedly suffered a toxic or adverse effect due to exposure to (e.g., ingestion of) a plant-incorporated protectant. (2) The producer has or could reasonably obtain information concerning where the incident occurred.

Id. § 174.71(b).

combination of statutory shortcomings, unfortunate interpretations, and problems with implementation and enforcement have resulted in FIFRA's lack of success as an environmental protection statute. Accordingly, there is considerable room for improvement. By revising FIFRA to follow the eco-pragmatic approach and to more consciously incorporate ecological principles, the statute could be improved substantially.

A. Reinventing the Cost/Benefit Balancing

To reinvent FIFRA in an eco-pragmatic mold, a number of changes are indicated. First, as described above, EPA's cost/benefit approach to registration and cancellation under FIFRA must be replaced with an open-ended balancing approach consistent with Congress' apparent intent in drafting the "unreasonable adverse effects on man and the environment" standard. Under such an approach, although economic and social costs would be considered in determining whether to allow a pesticide to be sold or distributed in the United States, they could not be used to "balance" away significant human health or environmental risks. Such risks would only be permitted in cases of overriding benefits of the pesticide, taking into account a number of specified considerations in the open-ended balancing.

The plain language of FIFRA, as it currently stands, does not mandate a strict cost/benefit balancing. Instead, as Shapiro and Glicksman have suggested, on its face FIFRA contains an open-ended balancing standard. As described above, FIFRA's definition of "unreasonable adverse effects on the environment" means any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide. Congress' only direction to EPA was to "take into account" economic and social as well as environmental considerations. Nevertheless, EPA has interpreted and implemented this standard as more of a strict cost/benefit balancing.³⁶⁹ However, at least with regard to pesticide registration, EPA does not engage in a true cost/benefit analysis because it does not require applicants to demonstrate the benefits of the pesticide. Moreover, as described above, EPA generally does not require efficacy data prior to registering a pesticide. EPA has, by rule, waived all requirements to submit efficacy data unless the pesticide product "bears a claim to control pest microorganisms that pose a threat to human health . . . or a claim to control vertebrates (such as rodents, birds, bats,

369. *Env'tl. Def. Fund, Inc. v. EPA* (heptachlor-chlordane), 548 F.2d 998, 1004 (D.C. Cir. 1976), *cert. denied*, 431 U.S. 925 (1977); *In re Chapman Chem. Co.*, FIFRA Docket No. 246, 1 E.A.D. 199 (EPA 1976); *In re Protexall Prod., Inc.*, FIFRA Docket No. 625, 2 E.A.D. 854 (EPA 1989).

canids, and skunks) that may directly or indirectly transmit diseases to humans.³⁷⁰ Accordingly, at the time of a registration decision, EPA does not know how efficacious a particular pesticide is. Further, at the time of registration, EPA does not determine whether more efficacious alternatives, including non-chemical alternatives, exist. Thus, at the time of registration, EPA does not know the extent of the benefits of the pesticide. Instead, benefits are assumed.³⁷¹ When coupled with the limited cost data that EPA considers, EPA's cost/benefit analysis is not a true cost/benefit analysis and is flawed in many respects.

Technology-based approaches, which have worked well in other areas of pollution control law,³⁷² may not work as well where the goal is to release substances into the environment with the intent to kill living organisms. Thus, a different approach may be necessary. FIFRA differs from many other environmental laws in that the environmental risks sought to be reduced by other such laws are by-products of activities intended to produce some other product or service (e.g., air pollution from energy production), whereas with FIFRA, the pesticide that poses the risk is the intended product. Accordingly, under FIFRA, the imposition of technology standards to reduce risks would take a different form than other technological controls that seek, for example, to reduce air pollution emissions. The FIFRA analogue of the technology-based standard, therefore, is an alternative reduced-risk method of pest control. Such an alternative can be either a lower risk chemical pesticide, or other non-chemical methods of pest control, such as biological control or cultural control.³⁷³

FIFRA's balancing standard should be revised to make clear that it is an open-ended balancing rather than a strict cost/benefit balancing. In addition to the economic considerations that the statutory standard directs EPA to consider in conducting this balancing, the statute should be revised to explicitly direct EPA to consider additional factors aimed at ensuring ecological concerns are adequately valued in the balancing. For

370. 40 C.F.R. § 158.640 (2005). The only pesticides for which EPA requires efficacy data are pesticides intended to control microbial organisms that affect human health and certain vectors of public health diseases. *See id.* (containing product performance data requirements for antimicrobial agents, products for treating water systems, and pesticides intended to kill or repel rodent, avian, and bat vectors). However, EPA has reserved the right to require, on a case-by-case basis, submission of efficacy data for other pesticides. *Id.*

371. In determining whether to register a pesticide, EPA assumes a manufacturer would not invest the resources necessary to support registration and commercialization of the pesticide unless the pesticide was efficacious and thus has benefits. Of course, the billions of dollars consumers spend each year on weight loss products, anti-balding products, and wrinkle cream suggest that marketability and efficacy are not necessarily one in the same.

372. *See generally* Wagner, *supra* note 95.

373. Biological controls include predator or parasites of pest insects. Cultural controls include cultivation, sanitation, crop rotation, and sowing and harvesting practices. *See supra* notes 174–77 and accompanying text.

example, considerations such as the degree of uncertainty regarding risks, the level of probability or risk, the degree of harm that could occur, and the likelihood of a pesticide to spread or reproduce in the environment, either through biological means as in the case of GMOs or physical means,³⁷⁴ are all factors that should be given serious consideration in any open-ended cost/benefit balancing.

Another recommended revision to EPA's cost/benefit approach to FIFRA registration is to require that the assumed benefits of a pesticide actually be demonstrated. As discussed above, FIFRA does not mandate, and EPA has opted not to require, that efficacy data be provided when registering a pesticide.³⁷⁵ Nor does EPA require that applicants for pesticide registration provide data showing that cost-effective alternative pest control methods are not available. Likewise, EPA does not require applicants to demonstrate that their proposed pesticide is relatively beneficial, either environmentally or economically, over other existing pesticides or pest control methods that are available to address the target pest. EPA merely assumes that a pesticide manufacturer would not incur the costs of developing and marketing a pesticide if it was not efficacious and did not have benefits and that any pesticides that are not beneficial will be eliminated through market forces. Consequently, a manufacturer could obtain a registration for a pesticide without ever having to show that the pesticide works for its intended purpose, let alone that the pesticide is necessary for combating particular pests or that existing chemical or non-chemical alternatives are not available. Virtually no chemical pesticide is without at least some risk. Thus, it is at least possible, if not likely, that registered pesticides pose some risks but have not been demonstrated to have any significant environmental, economic, or societal benefit.

It is not until EPA considers whether to cancel the registration of a pesticide that it evaluates the benefits of the pesticide and whether there are viable alternatives available. In determining whether to proceed with cancellation, EPA necessarily makes a threshold determination that the risks posed by a pesticide are significant. Once that determination is made, EPA conducts a full cost/benefit analysis. It is only at this point that EPA takes a look at the economic benefits of the pesticide.

374. Physical means of environmental dissemination include the tendency of a pesticide to move great distances through soil, water, or air, and the tendency of a pesticide to bioaccumulate.

375. The lack of a requirement for efficacy data is in contrast to other licensing statutes such as the licensing provisions of the FDCA governing the approval of new drugs, which explicitly requires a finding that a drug is "effective" as part of the premarket review process. A new drug is considered to be "effective" if there is a general recognition among experts, founded on substantial evidence, that the drug in fact produces the results claimed for it under prescribed conditions. 21 U.S.C. § 355 (2000).

However, when conducting a benefits analysis, EPA's analysis of alternatives is typically limited to other registered pesticides for the same use, which are assumed to be efficacious if they are registered. EPA's consideration of non-chemical alternative pest control techniques, such as cultural control, biological control, or organic farming practices, has proven extremely limited and cursory. Moreover, when evaluating whether existing chemical alternatives are available for the target pest, EPA does not conduct a comparative risk analysis, which could lead to a less risky pesticide being cancelled because other alternatives exist, but as more and more pesticides are cancelled, the benefits of the remaining pesticides grow. Thus, the benefits of the "last pesticide standing" will be very high because no alternatives exist. Accordingly, the last pesticide standing will have benefits that outweigh the risks even if the risks are relatively high. This problem could be solved by requiring a true benefits analysis for each registered pesticide, including a consideration of non-chemical alternatives, and conducting relative risk analysis that compares the risks of pesticides targeted toward a particular pest. It should be noted that although it does not routinely consider the relative risks of alternative pesticides when making registration or cancellation decisions, EPA has implemented certain policies to encourage development and registration of lower risk pesticides. In 1997, EPA issued Pesticide Registration (PR) Notice 97-3, which sets forth EPA's policy for the expedited review of conventional pesticides under the reduced-risk initiative and of biological pesticides.³⁷⁶ The goal of the policy is to encourage the development, registration, and use of lower-risk pesticides products "which would result in reduced risks to human health and the environment, when compared to existing alternatives." To accomplish this goal, EPA offers the incentive of an expedited registration review for qualifying products. Qualifying pesticides include those that "may reasonably be expected to accomplish [one] or more of the following: (i) Reduce the risks of pesticides to human health; (ii) Reduce the risks of pesticides to nontarget organisms; (iii) Reduce the potential for contamination of groundwater, surface water, or other valued environmental resources; and (iv) Broaden the adoption of integrated pest management strategies."³⁷⁷

376. This policy was developed partially in response to the 1996 Food Quality Protection Act that mandates EPA to develop procedures and guidelines for expedited pesticide review. The policy supersedes EPA's prior reduced-risk criteria published in *Incentives for Development and Registration of Reduced Risk Pesticides*, 57 Fed. Reg. 32,140 (July 20, 1992); and *Incentives for Development and Registration of Reduced-Risk Pesticides Program*, 58 Fed. Reg. 5,854 (Jan. 22, 1993).

377. These criteria are found in FIFRA § 3(c)(10), 7 U.S.C. § 136a(c)(10) (2000). EPA has further interpreted these criteria to develop a list of factors that will most significantly contribute to EPA's decision to grant reduced risk status. These factors include, in descending order of importance: very low mammalian toxicity; toxicity generally lower than alternatives (10–100X);

Moreover, with regard to the costs side of the equation, EPA's analyses, although more complete than for benefits, do not fully address the suite of environmental risks posed by pesticides.³⁷⁸ Most of the indirect environmental and economic costs of pesticide use are not considered.³⁷⁹ Environmental and economic costs not typically addressed in any meaningful way in pesticide cost/benefit analyses include: domestic animal poisonings and contaminated products; destruction of beneficial natural predators and parasites; honeybee and wild bee poisonings and reduced pollination; crop and product loss; ground and surface water contamination; fishery losses; adverse effects on wild birds and mammals; adverse effects on microorganisms and invertebrates; and adverse effects on ecosystem services. In 1993, Cornell Professor David Pimentel estimated that if the full environmental and social costs of pesticide use are taken into account, including indirect effects, the environmental and social costs of pesticide use would be significantly greater than \$8 billion/year.³⁸⁰ Pimentel estimated that of this \$8 billion/year, users of pesticides in agriculture pay only approximately \$3 billion/year, leaving the remaining \$5 billion/year to be borne by society.³⁸¹ Moreover, Pimentel points out that many of the true costs of pesticide use are either not well understood or difficult to quantify. Thus, the true cost of pesticide use may be even higher. Unfortunately, EPA considers very few

displaces chemicals that pose potential human health concerns [e.g., organophosphates, probable carcinogens (B2s)]; reduces exposure to mixers, loaders, applicators, and reentry workers; very low toxicity to birds; very low toxicity to honeybees, significantly less toxicity/risk to birds than alternatives; not harmful to beneficial insects, highly selective pest impacts; very low toxicity to fish; less toxicity/risk to fish than alternatives; potential toxicity/risk to fish mitigatable/ similar toxicity to fish as alternatives, but significantly less exposure; low potential for groundwater contamination; lower use rates than alternatives, fewer applications; low pest resistance potential (i.e., new mode of action); highly compatible with IPM; and efficacy. EPA, Pesticide Registration Notice, *Notice to Manufacturers, Formulators, Producers and Registrants of Pesticide Products* (1997), available at http://www.epa.gov/opppmsd1/PR_Notices/pr97-3.html.

378. It is not clear why EPA has focused its attention on human health risks and has given short shrift to ecological concerns. While EPA certainly has the legal authority to address ecological concerns, its focus continues to be human health concerns. Nowhere is this more apparent than in the area of pesticide regulation. Professor Holly Doremus has raised the issue of whether EPA's emphasis on human health concerns, as opposed to ecological concerns, stems from the institutional setting of EPA's pesticide program. Letter from Holly Doremus, Professor, U.C. Davis School of Law, to author (July 27, 2005) (on file with author). Although a full evaluation of this issue is beyond the scope of this article, the history of the EPA pesticide program may be a factor in creating such a bias. Prior to the creation of the EPA, pesticides, to the extent they were regulated, were under the jurisdiction of the U.S. Department of Agriculture. When EPA was formed, many of the USDA employees working on pesticide issues moved to the EPA pesticide office. Perhaps this created a culture focused on promoting agriculture even at the expense of ecological harm. Another explanation for this institutional bias may simply be that, from a political standpoint, it is easier to justify imposing costs on industry or farms to protect human health than it is to protect ecological resources.

379. See generally Pimentel, *supra* note 225.

380. *Id.* at 72.

381. *Id.*

of these costs when conducting the cost/benefit analysis it relies on to register a pesticide. Additionally, given the way EPA has interpreted FIFRA, even a very small risk may warrant cancellation of a pesticide, provided that the benefits are very low.³⁸² Conversely, presumably, even a very high risk may not trigger cancellation if the economic benefits to be achieved are very high. By this logic, if a pesticide poses a great economic benefit, high risks to vulnerable species or ecosystems will be tolerated.

Another area in which EPA's current approach to regulating pesticides is lacking is with regard to threatened and endangered species. The Center for Biological Diversity recently reported that EPA has approved registrations for pesticides that put more than 375 Endangered Species Act (ESA) listed species at risk.³⁸³ In the past several years, EPA has come under considerable attack for its failure to adequately address risks to certain species listed under the ESA³⁸⁴ from pesticide uses. Since the 1989 *Defenders of Wildlife* case, in which EPA was found liable for a take under the ESA for allowing the continued registration of pesticides containing strychnine, which harmed certain listed species, it has been clear that EPA is not only obligated to comply with the consultation requirements under the ESA when making decisions regarding pesticide registration, but the agency is also obligated to ensure that the permitted use of a registered pesticide will not result in an unauthorized take of a listed species.

Nevertheless, in the years since the *Defenders of Wildlife* decision, EPA's actions with regard to the protection of listed species from pesticides have been limited and have failed to carry out the mandates of the ESA. EPA's policy regarding pesticides and endangered species has consisted of requiring certain pesticide product labels to direct users to county bulletins, which identify on a map the range of listed species in the county. In the past several years, EPA has come under increasing criticism for its failure to fulfill its obligations under the ESA.³⁸⁵ In

382. In the Matter of Protexall Products, Inc., FIFRA Docket No. 625, 2 E.A.D. 854 (EPA 1989) (upholding cancellation of sodium arsenate ant baits which posed a small risk of minor illness to children because the benefits of the pesticide were minimal).

383. BRIAN LITMANS & JEFF MILLER, CTR. FOR BIOLOGICAL DIVERSITY, SILENT SPRING REVISITED: PESTICIDE USE AND ENDANGERED SPECIES (2004), <http://www.biologicaldiversity.org/swcbd/Programs/science/pesticides/REPORT.pdf>.

384. 15 U.S.C. §§ 1531–1544 (2000).

385. While a detailed discussion of the issues related to the relationship between pesticide laws and the Endangered Species Act is beyond the scope of this Article, those issues are the subject of a forthcoming article by the author. For a further discussion of these and related issues, see Patti A. Goldman, *Protecting Endangered Species From Pesticides: Making the ESA Work or Finding Loopholes*, SJ023 A.L.I.-A.B.A. 31 (2003); Pierre Mineau, *Birds and Pesticides: Are Pesticide Regulatory Decisions Consistent with the Protection Afforded Migratory Bird Species Under the Migratory Bird Treaty Act?*, 28 WM. & MARY ENVTL. L. & POL'Y REV. 313 (2004). See also Marcilynn A. Burke, *Klamath Farmers and Cappuccino Cowboys: The Rhetoric of the Endangered Species Act and Why it (Still) Matters*, 14 DUKE ENVTL. L. & POL'Y F. 441, 487–91

particular, in September of 2004, environmentalists won a significant victory when the Ninth Circuit affirmed a January 2004 U.S. District Court for the Western District of Washington order which found that EPA had violated the ESA because it had failed to take steps to ensure that the registration of fifty-four pesticides would not jeopardize the survival of listed salmon species. The appeals court's ruling upheld the district court's injunction, which imposed detailed buffer zones restricting the use of more than thirty pesticides along listed salmon supporting waters in California, Oregon, and Washington states.³⁸⁶

The federal government's response to the criticisms regarding EPA's failure to fully comply with the ESA, as well as its recent court losses, has been to amend the joint regulations for consultation under section 7 of the ESA.³⁸⁷ On August 5, 2004, a final rule was published in the Federal Register Final Rules that, in essence, allows EPA to avoid consultation with the federal wildlife agencies regarding whether new pesticides could cause harm to species listed under the ESA. Under the new rule, EPA will conduct its own reviews, which will simplify the process.³⁸⁸ The agencies' purported rationale for the new rules is to provide a more efficient approach to make decisions on whether new pesticides will "adversely affect" a listed species.³⁸⁹ However, environmental groups fear that the new rule will undercut the ESA and put listed species at greater

(2004) (discussing a number of regulatory attempts to weaken the consultation process including with regard to pesticide registration).

386. See *Wash. Toxics Coalition v. EPA*, No. C01-013132C (W.D. Wash. Jan. 22, 2004), available at <http://www.epa.gov/espp/wtc/index.html>. This order was the third in a series of orders granting injunctive relief to the environmental plaintiffs in this matter. See also *Wash. Toxics Coalition v. EPA*, No. C01-013132C (W.D. Wash. July 16, 2003), available at <http://www.epa.gov/espp/wtc/index.html>; *Wash. Toxics Coalition v. EPA*, No. C01-013132C (W.D. Wash. Aug. 8, 2003), available at <http://www.epa.gov/espp/wtc/index.html>.

387. The two ESA consulting agencies, the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS), and the U.S. Department of Agriculture adopted the new regulation as a joint regulation. Joint Counterpart Endangered Species Act Section 7 Consultation Regulations, 69 Fed. Reg. 47,732 (Aug. 5, 2004) (to be codified at 50 C.F.R. pt. 402).

388. According to EPA officials, the consultation process was not working. EPA frequently ignored the consultation requirements because of the "complexity of considering thousands of chemical's [sic] potential effects on 1,200 ESA-listed species." Greenwire, *Pesticides: EPA Will No Longer Have to Consult Wildlife Agencies* (July 30, 2004) available at <http://www.eenews.net>.

389. According to EPA officials, FWS and NMFS have only completed approximately twelve consultations on pesticides in the past ten years. Between 2002 and August of 2004, EPA had sent the wildlife agencies approximately thirty pesticide consultations, but none have been completed. EPA, *Endangered Species Effects Determinations and Consultations; An Interim Process for Public Input*, <http://www.epa.gov/oppfead1/endanger/effects/> (last visited Apr. 6, 2006).

risk. Consequently, a number of environmental organizations have filed suit alleging that the new rule violates the ESA.³⁹⁰

Concerns with rare or sensitive species or ecosystems can be addressed by an open-ended balancing approach, where the agency is directed to consider costs, but not in a strict cost/benefit monetized balancing. Under such an approach, although costs would be taken into consideration, the agency could be directed to afford greater weight in its balancing to other specified factors such as environmental justice concerns, risks to threatened or endangered species, risks to rare species, or risks to vulnerable ecosystems. It should be noted, however, that under this proposal the analysis would not end with the open-ended balancing. A second step, described more fully below, would require the consideration of local factors, such as the presence of threatened or endangered species, that could be effected by the use of the pesticide in that location.³⁹¹

FIFRA's cost/benefit approach also raises concerns with regard to the pesticidal GMOs.³⁹² EPA's cost/benefit approach raises particular

390. On September 23, 2004, a coalition of eight environmental groups filed suit challenging the Joint Counterpart Endangered Species Act Regulation. *Greenwire, Pesticides: Enviros Sue Over New Consultation Rule* (Sept. 24, 2004) available at <http://www.eenews.net>.

391. Although the possibility of harm to threatened or endangered species should be considered and afforded weight in the open-ended balancing analysis, it would be noted that under the ESA jeopardy to listed species can not be "balanced" away by cost considerations. Accordingly, in the second-step localized decision-making process, specific risk to listed species from the application of the particular pesticide in that particular locale must be evaluated under the ESA. Pesticide applications that do not comply with the ESA would be prohibited.

392. The worldwide concern over the safety of biotechnology products is evidenced by the significant role that biotechnology played in the negotiations of the United Nations Convention on Biological Diversity. The agreement eventually reached contained a number of provisions relevant to biotechnology. Two provisions in particular, Article 8 (In-situ Conservation) and Article 19 (Handling of Biotechnology and Distribution of its Benefits), were directed at addressing international concerns with biotechnology products. Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Jan. 29, 2000, 39 I.L.M. 1027 (2000).

Article 8 of the Convention requires that Contracting Parties establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology that could affect the conservation and sustainable use of biological diversity. Neither FIFRA's export provisions nor EPA's plant-incorporated protectant rule address the broader concern of risk to biological diversity internationally. It is conceivable that a pesticide, particularly a plant-incorporated protectant, which does not pose an unreasonable risk in the United States, could pose an unreasonable risk in another country. As discussed above, many of the risk issues associated with plant-incorporated protectants relate to their ability to outcross to wild relatives. This is a very different situation than that of conventional pesticides. For conventional chemical pesticides, the risks posed by the substance will tend to be similar regardless of the country or part of the world. For example, if a pesticide is highly toxic to humans or other mammals in the United States, it will also be highly toxic to humans or mammals in other countries. The risks associated with plant-incorporated protectants, on the other hand, may vary more with location depending on a number of factors such as the presence of wild relatives. It would be extremely difficult, if not impossible, for EPA to evaluate all risks of a plant-incorporated protectant in every country in the world. Moreover, to conduct the unreasonable adverse effects analysis required by FIFRA, EPA also must look at

concerns with regard to pesticidal GMOs that are exported, or that naturally spread, to other parts of the world. For example, one risk concern with plant-incorporated protectants is whether a favorable ecological niche exists for the modified plant in its new environment that will enable the plant to thrive, and perhaps become a pest or disrupt the balance of ecosystems. EPA may evaluate a particular pesticidal GMO under FIFRA and may find it will not pose an unreasonable environmental risk in the United States because a suitable niche does not exist for the modified plant in the United States that would allow the creation of a pest. To determine whether the pesticidal GMO poses an unreasonable risk in another country, however, the exporting company (or EPA) would be required to identify the types of ecosystems that exist in that country and the likelihood that the modified plant would thrive or spread in that environment. To do this, the exporting company (or EPA) would have to address a wide array of issues to determine whether the pesticide produced by the plant gives it a selective advantage in the new environment. Such a determination would depend on a number of considerations such as whether the modified plant has wild relatives in the new environment, how the modified plant is affected by factors such as climate, what selective pressures—e.g., viruses or other pathogens that normally keep the plant population in check—exist in the new environment, and how the modified plant interacts with the types of species present in the various ecosystems of the importing country. It appears unreasonable to require such a site-specific risk assessment for every country that imports U.S. pesticides. Nevertheless, international concerns could be averted if the United States were to participate in international efforts to provide advanced informed consent prior to exporting GMOs to other countries. Such a process is contemplated by the Rio Convention on Biodiversity, as well as the Cartagena Biosafety Protocol, neither to which the United States is a signatory.³⁹³

the societal benefits associated with the pesticide. It would seem infeasible for EPA to conduct such an analysis for every importing country. EPA is not in a position to evaluate, and place value on, the economic and societal benefits that an importing country derives from a particular pesticide or chemical substance.

Another impediment to EPA addressing risks of plant-incorporated protectants in countries other than the United States is that FIFRA provides EPA with very limited authority to regulate exported pesticides. The export of pesticides is regulated under section 17 of FIFRA. *See* 7 U.S.C. § 136o (2000). The primary emphasis of this section is on the provision of information by EPA to foreign governments. *Id.* Section 17 mandates two systems of notification: a notice to the government of an importing country of the export of unregistered pesticides, and a notice to all countries of cancellation or suspension actions taken by EPA. *Id.* §§ 136o(a)(2), 17o(b). Beyond these notification provisions, FIFRA does not provide EPA with the authority to regulate exports.

393. Article 19(3) of the United Nations Convention on Biodiversity provides: "The Parties shall consider the need for and modalities of a protocol setting out appropriate procedures, including, in particular, advance informed agreement, in the field of the safe transfer, handling

B. *An Ecological Integrity Baseline*

As described above, one cornerstone of eco-pragmatism is an environmental baseline. By incorporating ecological principles into eco-pragmatism, the notion of ecological integrity emerges as the environmental baseline. Consequently, any action taken under FIFRA can be evaluated according to its effect on the ecological integrity baseline. As with any baseline, however, such comparisons cannot be made without good data and ongoing monitoring. To ensure that pesticide usage does not undermine ecological integrity, a number of revisions to the FIFRA program are necessary.

Perhaps most importantly in this regard, EPA's data requirements must be revised to require data better designed to evaluate risks to wildlife species, ESA listed species in particular, as well as ecosystem services such as pollination, decomposition, nitrogen fixation, and other ecological services provided by organisms that may be affected by pesticides. Currently, EPA's data requirements for pesticide registration only address some of these concerns.³⁹⁴ EPA's data requirements for testing for ecological effects are limited, and not many such data requirements have been developed. In addition to substantial data requirements related to product chemistry,³⁹⁵ much of EPA's requirements regarding data necessary to support the registration of a pesticide focus on human health effects. For example, EPA has extensive data requirements related to residue chemistry to estimate human exposure to pesticides, acute human hazard, subchronic human hazard, chronic human hazard, mutagenicity, metabolism studies, reentry hazard,

and use of any living modified organisms resulting from biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity." The Cartagena Protocol on Biosafety implements this directive by including a provision that requires advanced informed agreement by the importing party prior to the first international transboundary movement of living modified organisms for intentional introduction into the environment. Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Jan. 29, 2000, 39 I.L.M. 1027 (2000).

394. The minimum data requirements for registration, experimental use permits, and reregistration are set forth in 40 C.F.R. pt. 158 (2005). More detailed standards for conducting tests, guidance on evaluation, and reporting of data and additional guidance is provided in a series of advisory documents that EPA makes available to applicants and the public. *See id.* § 158.20(c). In its data requirement rules, EPA identifies some data as required and other data as "conditionally required." Conditionally required data are required only if the product's proposed pattern of use, results of other tests, or other factors meet the criteria specified in the rules. *See id.* §§ 158.25(a), 158.101. EPA's rules also allow certain data requirements to be waived if they are not applicable to the particular pesticide or use. *See id.* §§ 158.25(b) (setting forth policy on flexibility and waiver); 158.35 (describing the flexibility in data requirements); 158.45 (regarding waiver of data requirements). In addition, EPA's rules set forth varying data requirements for minor use of a pesticide—i.e., used on a minor crop—and biochemical and microbial pesticides. *See id.* §§ 158.60, 158.65.

395. *See id.* §§ 158.150, 158.153, 158.155, 158.160, 158.162, 158.165, 158.167, 158.170, 158.175, 158.180, 158.190.

and spray drift evaluation, as well as oncogenicity, teratogenicity, neurotoxicity, and reproductive effects in humans.³⁹⁶

EPA also requires the submission of environmental fate data, which are designed to "assess the presence of widely distributed and persistent pesticides in the environment which may result in loss of usable land, surface water, ground water, and wildlife resources; and, assess the potential environmental exposure of other nontarget organisms, such as fish and wildlife, to pesticides."³⁹⁷ Environmental fate studies include studies to determine the rate of pesticide degradation, metabolism studies to determine the nature and availability of pesticides to rotational crops and to aid in the evaluation of the persistence of a pesticide, mobility studies pertaining to leaching, adsorption/desorption, and volatility of pesticides, dissipation studies, and accumulation studies.³⁹⁸ Perhaps because environmental fate data are used to evaluate human exposure to pesticides, as well as wildlife exposure, these data requirements appear to be fairly comprehensive. However, EPA's data requirements regarding effects on wildlife and nontarget organisms are considerably less comprehensive.

With regard to ecological effects, EPA has, by rule, developed limited data requirements designed to evaluate wildlife and aquatic organisms, environmental fate, and nontarget insects. EPA's data requirements for effects on wildlife and aquatic organisms include avian toxicity studies³⁹⁹ and freshwater fish and invertebrate acute toxicity studies⁴⁰⁰ for most pesticides intended for outdoor use. Wild mammal toxicity, avian reproduction, simulated and actual field testing of mammals and birds, acute toxicity to estuarine and marine organisms, fish early life stage, aquatic invertebrate life cycle, fish life cycle and aquatic organisms accumulation, and simulated or actual field testing of aquatic organisms are only conditionally required⁴⁰¹ for most outdoor uses. As illustrated by EPA's primary focus on acute toxicity testing, EPA does not generally require data related to potential adverse effects of pesticides on wildlife behavior, neurology, reproduction, birth defects,

396. See *id.* §§ 158.202(a), (c), (e), (f), (g), 158.240, 158.390, 158.440, 158.340; see also *id.* § 158.34 (providing that certain human health effects data submitted to EPA must be flagged as indicating potential adverse effects).

397. *Id.* § 158.202(d)(1).

398. *Id.* § 158.202(d)(2)-(6). See also *id.* § 158.290.

399. Avian oral LD50 and dietary LC50s are required when using the preferred test animal species—the mallard and the bobwhite. *Id.* § 158.490.

400. Freshwater fish LC50 studies are required, with the preferred test species being the rainbow and bluegill fish and acute LC50 studies are required on freshwater invertebrates, with the preferred test species being *Daphnia*. *Id.*

401. *Id.* Conditionally required studies are required only on a case-by-case basis depending on the results of lower tier studies, such as acute and subacute testing, intended use pattern and environmental fate characteristics, or if certain specified criteria are met.

or other non-acute effects. Moreover, EPA's data requirements do not contain any studies aimed at evaluating effects on other species such as amphibians or reptiles or other species not specifically identified in the rules. Accordingly, EPA's wildlife data requirements should be revisited to determine what additional data requirements would more fully address the wide range of potential effects on fish and wildlife that may result from exposure to pesticides.

Likewise, EPA's data requirements for nontarget insects are limited. EPA does conditionally require acute toxicity testing for honey bees and other pollinators if the proposed use will result in honeybee or other pollinator exposure. However, EPA does not have any data requirements related to honeybee subacute feeding studies,⁴⁰² nontarget aquatic insects, or non-target predatory or parasitic insects.⁴⁰³ Moreover, EPA does not have any data requirements whatsoever related to soil microorganisms, which provide critical ecological services such as decomposition and nitrogen fixation, or any data requirements designed to evaluate the effects of pesticides on any other ecological services.

Although EPA's data requirements include some studies designed to evaluate risks to fish, wildlife, aquatic organisms, and nontarget insects, EPA's primary purpose in requiring such studies is not to determine *whether* to register a pesticide product but instead is to "provide data which determines the need for (and appropriate wording for) precautionary label statements to minimize the potential adverse effects to nontarget organisms."⁴⁰⁴ However, label requirements do not always provide sufficient protection against the environmental harms resulting from pesticides use.

Despite all of the testing and labeling that EPA imposes, large numbers of birds, insects, amphibians, and aquatic species, including threatened and endangered species, continue to be harmed by EPA-registered pesticides.⁴⁰⁵ While many label requirements that EPA imposes are aimed at protecting human users of pesticides,⁴⁰⁶ and children who

402. In its data requirements rule, EPA identifies this type of requirement as "reserved pending development of test methodology." *Id.* § 158.590.

403. In its data requirements rule, EPA identifies these types of requirements as "reserved pending further evaluation to determine what and when data should be required, and to develop appropriate test methods." *Id.*

404. *Id.* § 158.202(h)(1).

405. See BRIAN LITMANS & JEFF MILLER, CTR. FOR BIOLOGICAL DIVERSITY, SILENT SPRING REVISITED: PESTICIDE USE AND ENDANGERED SPECIES (2004), <http://www.biologicaldiversity.org/swcbd/Programs/science/pesticides/report.pdf>.

406. See 40 C.F.R. §§ 156.10 (general labeling requirements), 156.60 (human hazard and precautionary statements), 156.62 (human hazard toxicity categories), 156.64 (signal words for human hazard toxicity categories), 156.68 (first aid statement), 156.70 (precautionary statements for human hazards), 156.78 (precautionary statements of physical or chemical hazards), 156.200–212 (worker protection statements) (2005).

may inadvertently be exposed to pesticides,⁴⁰⁷ from accidental poisonings, EPA does require certain environmental hazard information to appear on pesticide labels. For example, if a pesticide intended for outdoor use contains an active ingredient with a specified level of acute mammalian or avian toxicity, the label must bear a precautionary statement such as "this pesticide is toxic to wildlife."⁴⁰⁸ If either accident history or field studies demonstrate that the use of the pesticide may result in fatality to birds, fish, or mammals, the pesticide label must bear a precautionary statement such as "this pesticide is extremely toxic to wildlife (fish)."⁴⁰⁹ Similarly, if a product intended for certain uses contains an active ingredient toxic to pollinating insects, the label must bear an appropriate label caution.⁴¹⁰ Finally, if a product is intended for outdoor use other than aquatic applications, the label must bear the precautionary statement "keep out of lakes, ponds or streams. Do not contaminate water by cleaning of equipment or disposal of wastes."⁴¹¹

Although EPA requires these precautionary statements on labels, their practical effect is unclear. For example, if a farmer intends to apply a particular pesticide to combat a particular pest of her crops and the pesticide label indicates it is toxic to wildlife, how will this information influence the farmer's behavior? It is unlikely that the farmer will choose not to apply the pesticide, because virtually all of the major chemical pesticides use in agriculture today are acutely toxic to at least some nontarget organisms. It is difficult to imagine that a statement on a label indicating that a product is toxic to wildlife will have any significant influence on user behavior. Without more specific directions about when, where, or how it is appropriate to apply the pesticide to minimize risks to wildlife, the farmer is left with an essentially useless warning. The lack of more useful directions to minimize risk is likely due to the fact that, because most chemical pesticides are acutely toxic to at least some wildlife, it is impossible to release them into the environment in large amounts without creating the possibility for harm to wildlife.

C. Addressing Uncertainty and Change

As described above, eco-pragmatism argues in favor of feasibility approaches rather than cost/benefit approaches. While this Article

407. See *id.* § 156.66 (child hazard warning).

408. The specified level of acute toxicity for mammals warranting such a statement is an oral LD50 of 100mg/kg or less. The specified level of acute toxicity for fish warranting such a statement is an LC50 of 1ppm or less. The specified level of acute toxicity for birds warranting such a statement is an oral LD50 of 100 mg/kg or less or a subacute dietary LC50 of 500 ppm or less. *Id.* § 156.85(b)(1), (2), (3).

409. *Id.* § 156.85(b)(4).

410. *Id.* § 156.85(b)(5).

411. *Id.* § 156.85(b)(6).

proposes a modified cost/benefit analysis—open-ended balancing—for the registration of a pesticide under FIFRA, it also proposes that a feasibility analysis be conducted for significant pesticide “use.” Currently, no federal system is in place and only very limited state or local systems exist that regulate the “uses” of pesticides registered under FIFRA other than the label instructions on each registered pesticide. These label instructions are generally the same nationwide. Thus, there is not currently a widespread system for considering local factors to determine what pest control method should be used in what location under what circumstances.

As described above, for an environmental regulatory system to be eco-pragmatic it must be flexible and able to adapt to new information and changed circumstances. Transferring some decision-making authority to a local level is one way to accomplish this goal. The consideration of local factors in making the determination of whether or how to use a specific pesticide in a specific location is of particular import. The benefit of local control over pesticide use is that decisions can be made based on local factors. Such factors could include presence of threatened, endangered, or otherwise rare species, presence of sensitive species, soil conditions, climatic conditions, proximity to environmentally sensitive lands, types of crops grown, types of farming practices used, severity of pest infestations, or other relevant site-specific factors.⁴¹²

A variety of potential mechanisms are available for achieving local decision-making regarding actual pesticide use. One such mechanism is to encourage local government regulation of pesticide use. Another mechanism is to provide better training to certified applicators using integrated pest management (IPM) and non-chemical controls and better information regarding endangered species, ecological processes, the role of predators and parasites, and other local environmental conditions. Similarly, better training could be provided to local agricultural extension agents. A variation on this theme would be to empower local officials—whether they are local government officials or extension agent officials—to make case-by-case or season-by-season decisions on the actual use of pesticides. For example, a local official could be required to evaluate the local conditions—including the particular pest concerns, the climatic conditions, and a wide variety of local environmental factors—before “prescribing” that a particular pesticide be used. This idea is similar to that of a medical doctor prescribing that a patient take a particular medication. Prior to issuing such a prescription, the doctor would

412. Because ecological impacts are necessarily contextual and local, whereas human health impacts are not, EPA’s failure to adequately address local ecological effects of pesticides may be further evidence of an institutional bias away from ecological protection. See *infra* note 378 and accompanying text.

consider a number of factors such as the patient's overall health, other medical conditions, other medications the patient is taking, any allergies or sensitivities the patient may have to certain types of medications, the patient's age, the patient's health and lifestyle objectives, and the patient's willingness to accept certain risks to achieve such goals. Moreover, the doctor could adjust the type or amount of medication over time to fine-tune the treatment in accordance with changing circumstances or new information. A prescription-type approach to pesticide application could similarly adjust over time after consideration of changed local conditions or new information about local environmental factors. Of course, the physician-prescribed pharmaceutical system is not without its shortcomings. High pressure sales tactics by representatives of the pharmaceutical industry, glossy advertisements on television and in magazines promising that a wonderful life can be achieved merely by popping a pill, the public's desire for an "easy fix" in the form of a pill, and industry-sponsored research all may contribute to the trend of physicians over-prescribing medications. With a pesticide prescription system in place, pesticide manufacturers will likely be able to convince decision-makers to prescribe their pesticides. Nevertheless, such a system, if properly instituted, could result in at least some level of informed decision-making prior to the release of large amounts of pesticides into the environment. The likely criticisms of such a system would be that instituting such a system could entail high costs and possibly the creation of a new bureaucracy. However, relying on existing infrastructure to facilitate such a system without the need for a completely new institution or significant additional personnel may be possible. Perhaps the existing agricultural extension services could be used to administer such a system. Alternatively, existing state requirements for certified applicator training and certification could be expanded to better educate applicators about local environmental factors that should be taken into account and non-chemical alternative pest control mechanisms that in many cases may be preferable to chemical approaches. Such an approach might also rely on existing extension infrastructure and resources.

Although FIFRA provides a regulatory system that applies to any pesticide sold or distributed in the United States, FIFRA does not generally preempt state or local government regulation of pesticide use. In 1991, the right of a local government to regulate pesticide use was clearly established by the U.S. Supreme Court in the case of *Wisconsin Public Intervenor v. Mortier*.⁴¹³ In that case, a Wisconsin local government had adopted an ordinance which required a permit from the local government prior to certain types of pesticide use. Prior to the

413. 501 U.S. 597 (1991).

Mortier decision only a small number of states had in place laws that preempted local governments from regulating pesticide use. After *Mortier*, all but eleven states have laws preempting local regulation of pesticides.⁴¹⁴

Justice White, writing for the majority in the *Mortier* decision, recognized the benefit of local decision-making for the actual use of pesticides when he wrote: "FIFRA nowhere seeks to establish an affirmative permit scheme for the actual use of pesticides. It certainly does not equate registration and labeling requirements with a general approval to apply pesticides throughout the [n]ation without regard to regional and local factors like climate, population, geography, and water supply."⁴¹⁵ Yet this is, in practice, what FIFRA does. Once a pesticide receives a FIFRA registration, unless a particular state actively seeks to further regulate such a pesticide, it can be used anywhere in the United States with the only limitation that it must be used in accordance with the FIFRA label instructions. As is described more fully below, most states do not have detailed environmental permitting requirements for pesticide use.⁴¹⁶ Although EPA attempts to impose risk reducing measures on users through detailed labeling requirements, a set of instructions on a container that has been drafted to apply to the entire United States is a poor substitute for a site-specific, circumstance-specific decision on what pesticide to use where, when, and how.

The issue of localized decision-making regarding pesticide use has arisen in another context in recent years. Beginning with *Headwaters, Inc. v. Talent Irrigation District*⁴¹⁷ in 2002, the courts and EPA have been grappling with whether, and under what circumstances, a National Pollutant Discharge Elimination Systems (NPDES) permit is required under the Clean Water Act for the application of pesticides into waters of the United States.⁴¹⁸ Historically, EPA had not required NPDES permits for such pesticide applications. Thus, although EPA, at least arguably,

414. Haight, *supra* note 208, at 39. The U.S. Supreme Court recently addressed FIFRA preemption again in *Bates v. Dow Agrosciences*, 125 S. Ct. 1788 (2005) (holding that FIFRA does not preempt claims for defective design, defective manufacture, negligent testing, breach of express warranty, and violation of Texas Deceptive Trade Practices Act, and remanding the issue of whether FIFRA preempts fraud and failure-to-warn claims).

415. 501 U.S. at 613–14.

416. See *infra* notes 424–26 and accompanying text.

417. 243 F.3d 526 (9th Cir. 2001) (holding that the application of an aquatic pesticide to irrigation canals in compliance with the registration and labeling requirements under FIFRA did not eliminate the need for an NPDES permit).

418. For a detailed discussion of the judicial decisions and EPA's position on the issue of requiring NPDES permits for aquatic pesticide application, see Kelly C. Connelly, Note, *Pesticides and Permits: Clean Water Act v. Federal Insecticide, Fungicide and Rodenticide Act*, 8 GREAT PLAINS NAT. RESOURCES J. 35 (2003) and Paul Herran, Note, *Headwaters, Inc. v. Talent Irrigation District: Application of Aquatic Pesticides to Irrigation Canals, a Discharge, Which Requires a Clean Water Act Permit?*, 25 U. HAW. L. REV. 629 (2003).

has the legal authority to require permits that would consider localized environmental factors for applications of pesticides to waters, EPA has chosen not to do so. Even after the *Headwaters* decision, EPA has steadfastly refused to require NPDES permits for the application of pesticides directly to waters of the United States for the purpose of controlling pests in or over such waters.⁴¹⁹

In addition, as described above, nationwide decision-making regarding pesticides can lead to disproportionate risks being placed on vulnerable populations of people and on vulnerable species or ecosystems. While an overall cost/benefit analysis for a particular pesticide may weigh in favor of use of the pesticide, geographic or ecological "hot spots" may occur where the risks outweigh the benefits on those localized geographic areas or for those particular species. Without some way to bring localized concerns into the decision-making process, risks will continue to fall disproportionately on the most vulnerable human and ecological resources. Although over one-half of all registered agricultural pesticides are restricted-use pesticides,⁴²⁰ which must be applied only under the supervision of a certified applicator, the certified applicator requirement does not provide the level of oversight, consideration of local ecological factors, and consideration of lower risk alternatives needed to adequately address ecological risks. First, certified applicators do not necessarily directly oversee the application of pesticides, but instead typically serve as "arm chair" supervisors.⁴²¹ Second, certified applicators are not required to receive any particular training in local ecological systems and their vulnerability to particular pesticides.⁴²² Finally, although FIFRA section 11 requires EPA and states to make available to certified applicators instructional materials concerning IPM, the statute expressly states certified applicators are not required to receive instruction on IPM and are not required to demonstrate competence with respect to such techniques.⁴²³ Thus,

419. See Interim Statement and Guidance on Application of Pesticides to Waters of the United States in Compliance with FIFRA, 68 Fed. Reg. 48,385 (Aug. 13, 2003).

420. RODGERS, *supra* note 191, at 458.

421. See *infra* note 426 and accompanying text.

422. For a description of certified applicator training programs, see RODGERS, *supra* note 191, at 462-63.

423. 7 U.S.C. § 136i(c) (2000), regarding instruction in integrated pest management, provides:

Standards prescribed by the Administrator for the certification of applicators of pesticides under subsection (a) of this section, and state plans submitted to the Administrator under subsection (a) of this section, shall include provisions for making instructional materials concerning integrated pest management techniques available to individuals at their request in accordance with the provisions of section 136u(c) of this title, but such plans may not require that any individual receive instruction concerning such techniques or to be shown to be competent with respect to the use of such techniques. The Administrator and States implementing such plans shall provide

certified applicators are not required to know about less risky pest control techniques, let alone to consider them in making decisions regarding which options to choose to control a particular pest. In fact, a certified applicator's job is not to decide what approach to take to control a pest but is merely to ensure that once a particular pesticide is chosen, it is applied properly in accordance with label instructions.

Unfortunately, despite compelling reasons for considering local conditions in determining what pesticides to use in what locations and under what conditions, and the fact that FIFRA allows state and local governments to regulate pesticide use, state regulation of pesticides is minimal. Most states do not have regulatory systems more environmentally protective than FIFRA's basic nationwide protections. Most states do not have any significant regulations addressing the use of pesticides under localized conditions. For example, most states do not require obtaining site-specific permits before a pesticide can be applied, even for large scale agricultural pesticide application into the environment.⁴²⁴ Likewise, most states do not require anyone with specialized knowledge of the presence of threatened or endangered species or rare or sensitive ecosystems to make any evaluation prior to the release of pesticides into the environment. What state pesticide regulatory programs generally do is treat farmers as "private applicators," who are required to obtain a state certification that demonstrates that they have attained a level of practical knowledge of pesticide use and hazards, before such farmer is allowed to apply pesticides. Some states have more stringent requirements for chemigation, fertigation, and aerial application,⁴²⁵ but generally, once a

that all interested individuals are notified on the availability of such instructional materials.

424. Some states do have limited permitting requirements for pesticide use, however these requirements generally apply only to aerial application of pesticides and generally a permit is not issued for each application. For example, in Hawaii, a permit is required prior to aerial application of pesticides. HAW. CODE R. § 4-66-64 (Weil 2004). However, the permit can be issued for repeated uses or for a specified length of time. *Id.* at § 4-66-64 (a)(4). Consequently, changing local environmental conditions are not likely to be adequately addressed for each application. In Massachusetts, a permit is required for the aerial application of pesticides. However, the permit is for a one-year duration and is not specific to the date or time of application. 333 MASS. CODE REGS. 13.05(3)(b) (2006). Nevertheless, a site inspection is required prior to permit issuance, which presumably means that local condition are assessed prior to issuing the permit. *Id.* In addition, in Massachusetts, a special permit is required for application of restricted-use pesticides to an area greater than twenty-five acres. *Id.* § 13.03(18). Similarly, in Vermont, one-year duration permits are required for aerial application of pesticides. 20-031-012 VT. CODE R. § IV (5) (2006).

425. See, e.g., FLA. ADMIN. CODE ANN. r. 5E-9.019(2)(a) (2005) (aerial applicators require a separate certification); HAW. CODE R. § 4-66-64(6) (2004) (mandating a notice requirement prior to any aerial application); IDAHO ADMIN. CODE 02.03.03.310,320 (2006) (placing specific restrictions on aerial application geared primarily toward minimizing spray drift); 302 KY. ADMIN. REGS. 27:050 § 2(8) (2005) (requiring separate certification for aerial applicators); LA.

farmer has obtained the required training and certification, he is free to apply pesticides at will, provided it is done in accordance with FIFRA or state label directions and restrictions. What is more, generally the certified private applicator can "supervise" the application of pesticides by non-certified persons. In most states, "direct supervision" means that the certified private applicator is within a telephone call away from his supervisees.⁴²⁶ Some states do have specific pesticide regulations aimed at protecting groundwater or surface waterbodies. However, even these states do not generally require any form of site-specific permitting evaluation prior to pesticide use. By establishing a prescription-type system to large-scale pesticide use, not only will local environmental factors receive due consideration, but the system would have the

ADMIN. CODE tit. 7, pt. XXIII § 145 (2005) (detailing specific requirements regarding aerial application, including the requirement to adjust flight patterns to avoid sensitive areas and prohibitions on aerial application if wind velocity exceeds ten mph or if it is raining or rain is imminent); 333 MASS. CODE REGS. 13.05(3)(b), (c) (2006) (requiring a permit for aerial application, as well as prohibiting aerial application within 250 feet of a water body and requirements that aerial spraying cease if spray drift occurs); MICH. ADMIN. CODE r. 285.637.10 (2005) (detailing specific requirements regarding aerial spray drift, including a requirement for applicators to have a written spray drift plan in place and restrictions to protect sensitive areas); 25 NEB. ADMIN. CODE § 2-005.02B(1) (2005) (mandating separate certification requirements for application of restricted-use pesticides via chemigation); 2 N.C. ADMIN. CODE 9L.1002,.1003 (2006) (detailing spray drift control regulations and a prohibition on aerial application to restricted areas); 20-031-012 VT. CODE R. § IV (1)(b) (2006) (detailing rules regulating pesticide drift); WASH. ADMIN. CODE 16-202-2001 to -2021 (2006) (detailing rules regulating fertigation); WIS. ADMIN. CODE § 29.50(2) (2005) (listing restrictions to prevent significant spray drift).

426. See, e.g., FLA. STAT. § 487.021(64) (2005) ("under direct supervision" means that the licensed applicator is available "if and when needed"); IDAHO CODE ANN. § 22-3401(34) (2005) (stating that a supervisory certified applicator must be available as needed even though the "certified applicator is not physically present at the time and place the pesticide is applied"); MD. CODE REGS. 15.05.01.01(b)(23)(b) (2006) (stating that the supervisory certified applicator must be available if needed); NEB. REV. STAT. § 2-2642(5)(c) (2005) (defining "direct supervision" as available by voice or electronic means and the ability to be physically present if needed); N.J. ADMIN. CODE 7:30-1.2 (2005) (defining "available if and when needed" to mean that the direct supervisor must be able to be immediately contacted and no more than three hours away via ground transportation); OR. ADMIN. R. 603-057-0001(10) (2005) ("immediate supervision" defined as no more than five minutes away); VA. CODE ANN. § 3.1-249.27 (2005) ("under the direct supervision of" means the certified applicator is responsible for supervisees' actions); WIS. STAT. § 94.67(10m) (2005) (allowing private applicators to "direct the use of" restricted-use pesticides provided they are available if and when needed during the application).

Nevertheless, a few states do have more stringent supervisory requirements for certified applicators. See e.g., 355 IND. ADMIN. CODE 4-2-1(2)(A) and 4-2-3 (2006) (stating that if an applicator has never worked with a pesticide before or is not a "registered technician," the certified applicator must be both physically present and in direct voice contact during the application); 333 MASS. CODE REGS. 10.07 (2006) (requiring that the supervision of non-certified applicators increase based upon the hazard of the given pesticide being used); N.Y. COMP. CODES R. & REGS. tit. 6, § 325.7 (2005) (defining "under the direct supervision" to mean that the certified applicator must be physically present and within voice contact); and 20-031-012 VT. CODE R. § I(7)(17) and VII(1) (2006) (certified applicators must be physically present and actively supervise non-certified applicators).

flexibility necessary to adapt to changing circumstances and new information.⁴²⁷

As described above, one cornerstone of eco-pragmatism as well as conservation biology is adaptive management. Because of the complexity and changing nature of ecological systems, as well as our ever-increasing understanding of those systems, any system designed to address ecological risks must be flexible and able to adapt to changed circumstances and new information. Accordingly, a prescription approach, whereby a prescription for pesticide use is written based on a feasibility analysis for each large-scale application—or perhaps series of applications during a growing season—could serve as an adaptive management approach. Each time a localized decision must be made to prescribe a pesticide, current local conditions can be evaluated to determine the pest control that would maximize ecological protection to the extent feasible.⁴²⁸ Moreover, as new pesticides and non-chemical pest control techniques develop, they can be considered when determining what to prescribe.⁴²⁹

427. A possible alternative to a registration approach would be a reporting requirement on farms. Such an approach would be similar to the Toxics Release Inventory under the Emergency Planning and Community Right-to-Know program. 42 U.S.C. §§ 11001–11050 (2000). J.B. Ruhl has suggested such an approach as a way to provide regulators and local communities with information on pesticide releases. See J.B. Ruhl, *Farms, Their Environmental Harms, and Environmental Law*, 27 *ECOLOGY L.Q.* 263, 337–38 (2000). Although such an approach would not directly require the consideration of local ecological factors prior to use of a pesticide, by bringing pesticide releases under the scrutiny of regulators and communities, such an approach could result in long-term changes to pesticide usage.

428. For example, if in year two, an American Bald Eagle, or other listed species, builds a nest near the field to be sprayed, it may not be appropriate to prescribe the same pesticide used in year one if that pesticide is toxic to avian species. Likewise, if a listed species is no longer present near the field, it may be appropriate to go back to the more toxic pesticide. Similarly, if new information about the surrounding ecosystem is discovered, it could effect the decision of what pesticide to prescribe.

429. Although a detailed analysis of discounting environmental benefits is beyond the scope of this Article, as described in Part III above, many risks of pesticides are long-term risks. For example, the tendency of certain pesticides to bioaccumulate as they work their way up the food chain poses risks that may not be realized for many years after the initial release of the pesticide into the environment. Similarly, the harms from certain pesticides that pose reproductive effects, such as the endocrine disruptors, may not be to the animals exposed but may instead be to the offspring or even subsequent generations of the animals exposed. Moreover, many of the potential harms to ecological systems and services that pesticides pose, including disruptions of predator/prey relationships, harm to pollinators, and harm to microorganisms that perform decomposition and nutrient cycling services may not be evident in the short-term but may have significant long-term impacts. Accordingly, any pesticide regulation that reduces these long-term harms may not demonstrate immediate benefits. Consequently, as Farber suggests, it is important to ensure that the long-term benefits of pesticide risk reduction measures are adequately valued through the use of low discount rates. The idea of intergenerational equity further supports this notion. To ensure that future generations inherit functioning ecosystems, including functioning agricultural systems, it is incumbent upon this generation to ensure that the long-term benefits of pesticide-risk reduction measures are properly valued through appropriate low discounting.

CONCLUSION

Despite its early successes protecting ecological resources at the beginning of the environmental movement in the United States, FIFRA has virtually lain dormant with regard to ecological resource protection for the past twenty-five years. Ironically, if any area of environmental law should be tailored specifically to address ecological concerns, it is pesticide law, where substances intended to kill and disrupt species and natural systems are intentionally released into the environment in large quantities. Moreover, pesticide law has failed to keep pace with recent advances in ecology and conservation biology. The eco-pragmatic framework proposed by Professor Daniel Farber and elaborated upon by others may serve as useful approach to reinventing pesticide law to better address ecological concerns. To accomplish this, several steps are required. First, the prevailing interpretation of FIFRA's "unreasonable adverse effects standard" as mandating strict cost/benefit balancing should be reevaluated and adjusted to a more open-ended balancing standard, as contemplated by the drafters of the standard. Related to this idea, EPA's approach to evaluating whether a particular pesticide poses an unreasonable adverse effect on the environment should be modified so that registrants are required to demonstrate the true benefits of a pesticide by demonstrating efficacy and by evaluating the relative benefits of the pesticide to the benefits provided by other available pest control methods, including lower-risk chemical pesticides as well as non-chemical pest control methods. Second, to account for the uncertainties and long-term effects of pesticides on the environment, a low discount rate should be used in conducting the open-ended balancing analysis. Third, to ensure that pesticides released into the environment do not undermine a baseline of ecological integrity, the data requirements under FIFRA should be strengthened to require information about the potential effects on a wider variety of wildlife species as well as ecological services such as pollination, decomposition, and nitrogen fixation. Finally, an adaptive management approach should be developed to allow flexibility and adjustments to the choice of pest control method appropriate for a given situation. An adaptive management mechanism could be based on a medical prescription model which would allow for fine-tuning and adjustment as circumstances change over time or as new information becomes available. The prescription approach should be developed to allow localized decision-making regarding which pesticide is best for a given situation considering local environmental factors to determine the maximum level of environmental protection feasible for any given situation. The eco-pragmatic approach may provide the necessary framework for modifying U.S. pesticide law just enough so that we "do the best we can" to protect critical ecological resources.