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Environmental Law: Ethics or Science

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ENVIRONMENTAL LAW: ETHICS OR SCIENCE?

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INTRODUCTION: DISCORDANT HARMONIES, THE SOURCES OF ENVIRONMENTALISM AND WHY WE CARE

Environmental law has derived its legitimacy from an imperfect understanding of ecology and the theory that exposure to toxic chemicals is a substantial cause of cancer.[1] This article is about the

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* Associate Dean for Faculty and Professor of Law, Chicago-Kent College of Law, A.B. 1962, LL.B. 1965, Stanford University. This article is an on-going effort to probe the foundations of environmentalism and environmental law. My interest has been focused by two related, long-term inter-disciplinary activities in which I have been fortunate to participate. Between 1972 and 1995, I served on several National Academy of Sciences-National Research Council Committees and a board dealing with the application of physical and social science information to environmental regulation. The views expressed in this article are entirely my own, but I am grateful to the many scientists and NAS staff who have educated me in the practice and potential of science. In addition, since 1991, I have assisted my colleague Fred Bosselman, who has been a consultant to California Resources Agency, to develop a habitat conservation planning process to address endangered species issues in southern California within the broader framework of biodiversity protection. This experience has provided me with an on-going education in the new ecology and conservation biology. The same disclaimer applies, but I am ever grateful to Fred for his willingness to share his wisdom and knowledge about environmental and land-use issues with me.

I have addressed the impact of new "Botkinian" ecology on environmental law in two previous articles, A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOYOLA OF LOS ANGELES L. REV. 1121 (1994); A. Dan Tarlock and Fred P. Bosselman, *The Influence of Ecological Science on American Law: An Introduction*, 69 CHI.-KENT L. REV. 847 (1994). This paper is an extension of those two papers and benefits from a workshop at the University of Tulsa in April 1994; a seminar at the Martin-Luther-Universitaet-Halle-Wittenberg, Germany in June 1994, a presentation to Professor Bruce Hay's Advanced Environmental Law class at Harvard Law School, September 22, 1994 and from my participation in the Cummings Colloquium on Environmental Law, Beyond the Balance of Nature: Environmental Law Faces the New Ecology, at Duke University, April 18, 1996. Many commentators have been highly critical of my efforts to state a science-based justification for environmental management. I have taken many of these criticisms into account in this article, but the errors of learning and judgment remain my own.

1. For a review of changing theories of cancer causes and their influence on the legitimacy of environmental regulation of potential carcinogens see ROBERT N. PROCTOR, CANCER WARS: HOW POLITICS SHAPES WHAT WE KNOW AND DON'T KNOW ABOUT CANCER (1995). As with ecology, a major paradigm shift is occurring within the medical community about the best way to assess cancer risk. *See* Richard Stone, *A Molecular Approach to Cancer*

influence of two ecological paradigms on environmental law, primarily the law that relates to biodiversity conservation. My basic argument is that the displacement of the equilibrium paradigm with the non-equilibrium in ecology requires the development of a new, more complex and science-based environmental ethic for biodiversity conservation than the simple nature veneration ethic on which we have relied since the rise of environmentalism in the 1960's. New environmental ethics are needed because the legal implications of the non-equilibrium paradigm are substantial over space and time[2] and challenge the fundamental justifications for the law of biodiversity preservation, the strategies we have used to promote environmental values, the relationship between law and scientific research and the rules which structure environmental decision-making. The paradigm shift moves the emphasis from the simple permanent preservation of "natural areas" as the dominant biodiversity strategy to a combination of strategies which seek the maintenance of dynamic healthy ecosystems, ecosystem restoration and the increased use of adaptive management.

The principal argument of this article is that environmental law and management should derive their primary political power and legitimacy from science,[3] not ethics. This is a deliberately provocative statement because it runs counter to the pluralistic justification for environmental law, which posits that environmentalism can be sustained from multiple sources of legitimacy all of which are equal.[4]

Risk, 268 SCIENCE 356 (1995).

2. The non-equilibrium paradigm, as it is being applied to biodiversity protection, potentially dissolves the land boundaries that we have built up over centuries and extends the time scale of management decisions. Public versus private land, national parks versus national forests have no meaning. Under the non-equilibrium paradigm, all natural resources management is an on-going experiment instead of a series of discrete, final decisions. The net result is to raise the level of uncertainty as a constraint on rational decision making and to extend this uncertainty over a long period of time. *See* NATIONAL RESEARCH COUNCIL, SETTING PRIORITIES FOR LAND CONSERVATION (1993).

3. *See* Alfred C. Aman, Jr., *The Earth As Eggshell Victim: A Global Perspective on Domestic Regulation*, 102 YALE L.J. 2017, 2114-22 (1993).

4. For example, Donald T. Hornstein forcefully criticizes reliance on science-based risk reduction because it makes it difficult to move from effects-based to cause-based reforms and "it does not possess a mechanism to aggregate a citizenry's numerous, and subjectively held, individual risk preferences." Donald T. Hornstein, *Lessons from Federal Pesticide Regulation on the Paradigms and Politics of Environmental Law Reform*, 10 YALE J. ON REG. 369, 440 (1993). In short, science is important but we should not aspire to comprehensive rationality.

We have primarily borrowed from science, the Romantic tradition and Neo-Kantian ethics to justify environmental protection. Pluralism has served the environmental movement well. If science does not support a position, the problem may be reclassified as ethical.[5] As environmentalism matures, however, questions of legitimacy become more important and the pluralistic basis of environmentalism becomes more problematic by making legitimacy too contingent. The easy regulatory actions have been taken, and future actions intrude more deeply into personal choice and conflict more directly with the pursuit of other firmly rooted cultural interests.

A pluralistic approach to questions of legitimacy was adopted because environmentalism was alien to the Western intellectual tradition. This value pluralism was a logical and creative response to the paucity of intellectual sources of legitimacy for environmental law. The rapid acceptance of environmental protection as a legitimate basis for government regulation reversed the normal relationship between ideological debate and political action: action preceded theory. A rich, diverse and contradictory theoretical literature on the basis of environmentalism has developed to provide post-hoc rationalizations for the exercise of popular sovereignty. The public's seemingly unconditional acceptance of environmental regulation spared the environmental movement hard questions about its legitimacy.

My argument recognizes that science is neither a substitute for political decision-making[6] nor a meta-ethical framework to help make normative decisions about human-nature interactions.[7] Environmental protection is a social construct which may be undertaken for a variety of reasons or for none at all.[8] There is no constitutional requirement that environmental regulation be based on scientific understanding, and thus there are non-scientific justifications for environmental regulation. The argument also recognizes, as do most scientists, that

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5. *See* HOLMES ROLSTON, III, ENVIRONMENTAL ETHICS: DUTIES TO AND VALUES IN THE NATURAL WORLD 169-191 (1988).

6. James L. Huffman, *Markets, Regulation, and Environmental Protection*, 55 MONT. L. REV. 425, 427-429 (1994)

7. My argument owes a great deal to CHRISTOPHER D. STONE, EARTH AND OTHER ETHICS: THE CASE FOR MORAL PLURALISM (1987).

8. Elizabeth Ann R. Bird, *The Social Construction of Nature: Theoretical Approaches to the History of Environmental Problems*, ENVTL. REV., Winter 1987, at 255.

science is not value-neutral and thus has no special claim to immunity from public scrutiny.[9]

Environmentalism needs a mixed deontological and consequentialist theory. This assertion rests on three propositions. First, only science can establish the necessary conditions[10] for legitimate environmentalism because it constrains political choice:

> Politicians cannot exercise control over environmental outcomes without resource to scientific findings. They may claim that findings are not clear-cut or remain subject to contradictory interpretations, but they are nonetheless dependent on what the practices of science uncover about the laws of nature . . . criteria of proof are at the heart of environmental politics, . . . the outcomes of environmental issues depend as much on the persuasiveness of the evidence as on various criteria of power . . . .[11]

Second, my argument resists the tendency to respond to the contingencies and uncertainties inherent in environmental science by reclassifying problems as ethical rather than scientific.[12] Third, my argument rejects the view that environmental law is (or should be) grounded in monistic, non-anthropocentric "rights of nature."[13]

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9. For a good articulation of this position see LAWRENCE J. SUSSKIND, ENVIRONMENTAL DIPLOMACY: NEGOTIATING MORE EFFECTIVE GLOBAL AGREEMENTS 62-81 (1994).

10. See discussion, *infra* Part III, for my list of the necessary conditions for environmental "discourse" in the non-equilibrium paradigm era.

11. James N. Rosneau, *Environmental Challenges in a Global Context, in* ENVIRONMENTAL POLITICS IN THE INTERNATIONAL ARENA 257, 258 (Sheldon Kamieniecki ed., 1993). For a partial critique of this position see SUSSKIND, *supra* note 9, at 62-81.

12. The shift from science to ethics is traced in CHARLES T. RUBIN, THE GREEN CRUSADE: RETHINKING THE ROOTS OF ENVIRONMENTALISM (1994). *See also* Donald A. Brown, *After the Earth Summit: The Need to Integrate Environmental Ethics Into Environmental Science and Law,* 2 DICK. J. ENVTL. L. & POL'Y 1, 17 (1992). For a recent exploration of the ways in which idealized "nature myths" have impeded the development of science-based environmental management see STEPHEN BUDIANSKY, NATURE'S KEEPERS: THE NEW SCIENCE OF NATURE MANAGEMENT (1995).

13. The case for this proposition has been eloquently made by Christopher Stone, *Moral Pluralism and the Course of Environmental Ethics*, 10 ENVTL. ETHICS 139 (1988). The chief proponent of moral monism is J. Baird Callicott. *See, e.g.*, J. Baird Callicott, *The Case Against Moral Pluralism*, 12 ENVTL. ETHICS 99 (1990).

A. *The Romantic Science of the Land Ethic*

Since the 1960's, ecology has provided the justification for a wide range of prohibitions on human activities which alter "natural" land and water systems and, along with theories of cancer causes, for much of current pollution control regulation.[14] Legislators, regulators, resource managers and lawyers have derived a powerful and general lesson from ecology: let nature be. The ur-text is Aldo Leopold's synthesis of his ecologically-based land ethic: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."[15] Leopold's land ethic is the leading land-use management alternative to the progressive conservation movement's strategy of multiple-use[16] of resources and has provided the basis for power resource preservation and protection laws.[17]

Leopold was read to provide an ecological justification for the land ethic in the equilibrium paradigm in ecology, or, as it was crudely and popularly expressed, "the balance of nature." Lawyers and legislators enthusiastically embraced this paradigm because it seemed to be a neutral universal organizing principle that could be applied to the use and management of all natural resources. The contributions of modern environmental resource management to the legal system, such as the National Environmental Policy Act, the Endangered

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14. Frank B. Golley argues that the environmental movement seized on the concept of an ecosystem because it provided both a rational explanation of nature and moral management imperatives and ecologists papered over problems of theory and method as they "passively accepted the buzzing activity." FRANK B. GOLLEY, A HISTORY OF THE ECOSYSTEM CONCEPT IN ECOLOGY: MORE THAN THE SUM OF THE PARTS 3 (1993).

15. ALDO LEOPOLD, A SAND COUNTY ALMANAC AND SKETCHES HERE AND THERE 224-25 (1949). Curt Meine traces the evolution of Leopold's thinking based on his conservation experiences. CURT MEINE, ALDO LEOPOLD (1988).

16. For good case studies of this evolution see DAVID L. FELDMAN, WATER RESOURCES MANAGEMENT: IN SEARCH OF AN ENVIRONMENTAL ETHIC (1991) and RONALD A. FORESTA, AMAZON CONSERVATION IN THE AGE OF DEVELOPMENT: THE LIMITS OF PROVIDENCE 6-31 (1991). Leopold is the Socrates of post-modern environmental ethics. *See e.g.*, PAUL TAYLOR, RESPECT FOR NATURE (1988); J. BAIRD CALLICOTT, IN DEFENSE OF THE LAND ETHIC (1989); LAURA WESTRA, AN ENVIRONMENTAL PROPOSAL FOR ETHICS: THE PRINCIPLE OF INTEGRITY (1994).

17. Professor Eric T. Freyfogle is one of the leading academic legal exponents of the relevance of Leopold to environmental law and has extensively documented Leopold's influence on environmental law. *See e.g.*, Eric T. Freyfogle, *The Land Ethic and Pilgrim Leopold*, 61 U. COLO. L. REV. 217 (1990); Eric T. Freyfogle, *The Ethical Strands of Environmental Law*, 1994 U. ILL. L. REV. 819 (1994); Eric T. Freyfogle, *The Owning and Taking of Sensitive Lands*, 43 UCLA L. REV. 77 (1995).

Species Act, the Wilderness Act of 1964 and parts of the Clean Water Act (i.e. sec. 404), are premised on this paradigm. However, the equilibrium paradigm is now unraveling. Non-scientists, particularly lawyers, have a tendency to embrace ideas from other disciplines just at the time when the idea is decaying within the discipline. The gap between lay reliance on the equilibrium paradigm and its erosion within the scientific community is a classic example of the difficulty involved in developing an enduring foundation to support positive branches of the law, such as environmental law, which take their content from other disciplines.

The balance of nature or equilibrium paradigm solved the critical legitimacy problem for the development of a new branch of law. It enabled the legal system to use environmentalism,[18] rather than traditional legal values, as a source of legitimacy to construct a new branch of law. Environmental law is, to a greater extent than other areas of law, a product of external forces and is therefore difficult to integrate into our legal system. The Constitution, for example, is not a source of environmental rights and duties because environmental values were not at the forefront of Enlightenment thinking.[19] The thrust of environmentalism is not, and never has been, the enhancement of human dignity, but rather the need for humankind to subordinate itself to two communities, future generations and ecosystems, neither of which has a legal personality.[20]

The emergence of the non-equilibrium paradigm illustrates the need to revisit the question: What is the basis of environmental law? Since the equilibrium paradigm has been enshrined in environmental law, it has been rejected in ecology and replaced with a complex,

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18. T. O'RIORDAN, ENVIRONMENTALISM (2d ed. 1981) remains the best introduction to the forces which have combined to make natural environments a focus of human perception and intervention.

19. *See* A. Dan Tarlock, *Environmental Law, But Not Environmental Protection, in* NATURAL RESOURCES POLICY AND LAW: TRENDS AND DIRECTIONS 162, 167-169 (Lawrence J. MacDonnell & Sarah F. Bates eds., 1993); Joseph L. Sax, *The Search for Environmental Rights*, 6 J. LAND USE & ENVTL. L. 93 (1990).

20. Professor Roderick Nash has tried to situate environmentalism within the enlightenment tradition by arguing that environmental protection is a logical progression of the enlightenment legacy of the protection of human dignity. RODERICK NASH, THE RIGHTS OF NATURE: A HISTORY OF ENVIRONMENTAL ETHICS (1989). I am not persuaded. The Enlightenment tradition that we celebrate in our legal system is one of negative entitlements — freedom from presumptively arbitrary state power. In contrast, many of the most important environmental entitlements involve claims to affirmative, substantive resource allocations.

stochastic non-equilibrium paradigm.[21] In his path-breaking but still under-appreciated book, DISCORDANT HARMONIES, Professor Daniel Botkin "deconstructed" the equilibrium paradigm as a misguided effort to match science to theological and scientific visions of a perfect universe.[22] His basic argument is that static images of nature have influenced ecology, when in fact the resource-use problems faced by society require a dynamic view. The dynamic view of nature is based on the premises that human action is one of the principal forces operating on ecosystems and that system disturbances are both predictable and random. Ecosystems are patches or collections of conditions that exist for finite periods of time. The accelerating interaction between humans and the natural environment makes it impossible to return to an ideal state of nature.[23] At best, ecosystems can be managed rather than restored or preserved, and management will consist of calculated experimentation. "[N]ature moves and changes and involves risks and uncertainties and . . . our own judgments of our actions must be made against this moving target."[24]

B. *Botkin's Challenge to Environmentalism and Environmental Law*

Botkin's theories have profound ramifications for environmentalism and its derivative, environmental law. The non-equilibrium paradigm raises the basic question: What are the sources that legitimate environmental law? The paradigm makes it difficult to sustain ethically-based justifications for environmental law[25] because

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21. *See, e.g.*, Judy L. Meyer, *Changing Concepts of System Management, in* SUSTAINING OUR WATER RESOURCES 78 (National Research Council ed., 1993).

22. DANIEL B. BOTKIN, DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE TWENTY FIRST CENTURY (1990). Interestingly and ironically, the book seems to have attracted little attention in the scientific journals when it was first published, with the exception of a laudatory review by a physicist. *See* James Trefil, *Natural Changes Review of Discordant Harmonies: A New Ecology for the Twenty-First Century*, 41 BIOSCIENCE 176 (1991).

23. The philosophical basis for the new ecology can be found in Bill McKibben's widely read book which argues the modern mind separates humanity from nature and thus the romantic visions of harmony between humanity and nature are impossible. BILL MCKIBBEN, THE END OF NATURE 213-17 (1989). However, Justice Oliver Wendell Holmes in *Abrams v. United States*, 250 U.S. 616 (1919) (dissenting opinion), articulated the central message of the non- equilibrium paradigm. In defense of his "market of ideas" theory of the First Amendment, he wrote: "[o]ur Constitution . . . is an experiment, as all life is an experiment." *Id.* at 630.

24. BOTKIN, *supra* note 22, at 190.

25. For an early and powerful articulation of the problems of relying on ecosystems as a basis for environmental ethics see Harley Cahen, *Against the Moral Considerability of*

it focuses attention on the primacy of science as the basis for environmentalism and environmental law and on the need to resolve the tension among the three competing sources of environmentalism: ethics, religion and science.

Religion has not been and is unlikely to be a basis for a workable theory of environmentalism. Despite efforts to create a revisionist green theology of stewardship, religion remains more of a cause rather than a solution to environmental problems.[26] Environmentalism carries forward the Enlightenment faith in science, but runs fundamentally counter to both the Judeo-Greco-Christian and Enlightenment traditions of Western civilization.[27] Both identify "constitutionalism" as the fundamental legal basis for organizing society. From an environmental perspective both religion and Enlightenment thinking share the same defect: humankind is the exclusive interest.[28] The real legitimacy choice is between science and ethics.

Post-modern ethics have been used to construct non-anthropocentric environmental ethics.[29] One theory regards environmentalism as a progressive extension of the protection and enhancement of

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Ecosystems, 10 ENVTL. ETHICS 195 (1988).

26. The major religions have devoted a great deal of effort to constructing an environmental theology. This effort is to be applauded. *See e.g.*, SALLIE MCFAGUE, THE BODY OF GOD: AN ECOLOGICAL THEOLOGY (1993); ROSEMARY R. RUETHER, GAIA AND GOD: AN ECOFEMINIST THEOLOGY OF EARTH HEALING (1992); CHARLES BIRCH & JOHN B. COBB, JR., THE LIBERATION OF LIFE: FROM THE CELL TO THE COMMUNITY (1981). However, environmentalism is a hard issue for the major monotheistic religions because nature worship smacks of paganism. *See e.g.*, Steven S. Schwarzschild, *The Unnatural Jew*, 6 ENVTL. ETHICS 347 (1984) (arguing that the God of the Old Testament is a transcendent God — above nature). As Maimonidies said "nature is that which works effectively and well for human beings." *Id.* at 351. Eastern philosophy lacks the dualism of Western philosophy but has no respect for natural systems qua systems. Taoism sees life as a cyclical process with a rhythm and order, Roger Ames, *Taoism and the Nature of Nature*, 8 ENVTL. ETHICS 316 (1986), but it seems to have no ability to restrain human choice because "natural" and "human" actions are accepted equally as natural. J. Baird Callicott, the leading proponent of nonanthropentric ethics, has recently argued that a deep ecology can be found in Asian religious traditions, but his analysis makes it clear that it would be reconstruction based on environmental philosophy. J.BAIRD CALLICOTT, EARTH'S INSIGHTS: A SURVEY OF ECOLOGICAL ETHICS FROM THE MEDITERRANEAN BASIN TO THE AUSTRALIAN OUTBACK 44-108 (1994).

27. *See* JOHN PASSMORE, MAN'S RESPONSIBILITY FOR NATURE (1974).

28. The relationship between environmental rights and human dignity was extensively debated prior to the 1992 Rio Summit. *See, e.g.*, BIODIVERSITY AND INTERNATIONAL LAW 88-91 (Simone Bilderbeek ed., 1992).

29. THE ETHICS OF THE ENVIRONMENT xv-xxiv (Andrew Brennan ed., 1995).

human dignity and understanding.[30] Thus, environmental insults remain limited to the human body and resources valued by humans.[31] The opposite theory argues that environmental values must be based on nonanthropocentric theories because ecosystems have value independent of human attribution.[32] Ecological communities thus become moral subjects.[33] Botkin's work suggests that neither of these two competing theories of environmentalism is an adequate basis on which to construct an environmental ethic to sustain the necessary level of resource management and regulation. Both theories ultimately rely on the now-discredited equilibrium paradigm.[34] This has led to romantic notions about nature that are philosophical constructs rather than scientific theories. In short, Botkin's work presents an ecology based on more hard-edged probabilistic theories of non-equilibrium and rejects the vision of a balance of nature.[35] Further, it rejects the Romantic and deeply held popular idea that nature should be a place without humans and returns to the problem posed by Genesis: How should one manage the Garden of Eden after it has been invaded by humans?[36]

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30. The story of the development of anthropocentrisim has been told many times. Among the best are PASSMORE, *supra* note 27; I.G. SIMMONS, ENVIRONMENTAL HISTORY: A CONCISE INTRODUCTION 157-88 (1993); LUC FERRY, THE NEW ECOLOGICAL ORDER (Carol Volk trans., 1995).

31. *See* Holly Doremus, *Patching the Ark: Improving Legal Protection of Biological Diversity*, 18 ECOLOGY L. Q. 265, 269-275 (1991) (distinguishing among utilitarian, aesthetic and ethical bases of justification for biological diversity); STEPHEN R. KELLERT, THE VALUE OF LIFE: BIOLOGICAL DIVERSITY AND HUMAN SOCIETY 62 (1996) (identifying nine basic values and finding that despite expressions of ethical concerns for biodiversity "most Americans remain fixed on a narrow segment of the biotic community — largely vertebrate animals, particularly creatures of special historical, cultural and aesthetic significance").

32. J. Baird Callicott is the leading proponent of this theory. *See supra* notes 13, 26. For a recent review of his theories by a leading critic see Bryan G. Norton, *Why I am Not a Nonanthropocentrist: Callicott and the Failure of Monistic Inherentism*, 17 ENVTL. ETHICS 341 (1995).

33. *See* ROLSTON, *supra* note 5, at 169-191.

34. MICHAEL E. ZIMMERMAN, CONTESTING EARTH'S FUTURE: RADICAL ECOLOGY AND POSTMODERNITY 374-75 (1994), considers the impact of the new ecology of environmental ethics and reaches this conclusion after an extensive but ultimately frustrating "dialogue" about deep ecology, social ecology and ecofeminism.

35. *See* WALLACE KAUFMAN, NO TURNING BACK: DISMANTLING THE FANTASIES OF ENVIRONMENTAL THINKING (1994) (arguing that Botkin's book challenges the environmental religion).

36. Most environmental philosophy views the assertion of human primacy over nature as *the* original sin and tries to rectify this by radically shrinking the human role. *See, e.g.*, Callicott, *supra* note 26, at 14-43; *cf.* Judith M. Green, *Retrieving the Human Place in Nature*, 17 ENVTL. ETHICS 381 (1995).

This article takes issue with the current justification for environmental protection and the strategies that it produces,[37] and not with the need for environmental protection. The non-equilibrium paradigm does not undermine the need for biodiversity protection because it accepts the principal lessons of ecology, that unregulated, humans can damage ecosystems, and that the magnitude of human intervention is often too great.[38] In many instances, the paradigm strengthens the scientific case for ecosystem management while exacerbating the politics of that management. The non-equilibrium scale of management is larger and the emphasis is on the maintenance of processes that produce undisturbed systems. The new paradigm is also the basis for the argument that since nature is in flux, human change is just another "flux" to be tolerated; however, ecologists reject this argument because it undermines the functional, historical and evolutionary limits of nature.[39]

I. THE EVERGLADES AND PUTTING NATURE BACK TOGETHER

The influence of non-equilibrium ecology can be seen in various efforts underway either to restore ecosystems or to protect remnants of such systems that have been degraded. The Everglades may be used as an example to outline four important legal consequences of the non-equilibrium paradigm for modern environmental protection.

The Florida Everglades, which sit on a shallow bedrock trough in south Florida, formed during the Pliocene and Pleistocene eras and constitute one of the world's largest freshwater wetland systems. During the past 5,000 years a rich peat, marl and muck base has formed that supports a biologically diverse, water-dependent Caribbean and temperate ecosystem.[40] The southern part of the ecosystem was designated as a national park in 1947, while the northern part has been developed extensively for agricultural and

37. For an extremely factually and analytically flawed presentation of a similar argument, see GREGG EASTERBROOK, A MOMENT ON THE EARTH (1995).

38. *See* EDWARD O. WILSON, THE DIVERSITY OF LIFE (1992).

39. *See* Steward T.A. Pickett et al., *The New Paradigm in Ecology: Implications for Conservation Biology Above the Species Level, in* CONSERVATION BIOLOGY: THE THEORY AND PRACTICE OF NATURE CONSERVATION, PRESERVATION, AND MANAGEMENT 65, 82 (1992).

40. Patrick J. Gleason & Peter Stone, *Age, Origin, and Landscape Evolution of the Everglades Peatland, in* EVERGLADES: THE ECOSYSTEM AND ITS RESTORATION 149, 150 (Steven M. Davis & John C. Ogden eds., 1994).

urban use. The entire system, including the park, is under stress; the natural system depended on seasonable waterflows, and these flows have undergone a century of human alteration in the name of flood control, land reclamation (drainage) and conservation (urban growth). A levee was constructed parallel to the coastal ridge to stop sheet flows toward Palm Beach and Miami, and basins and canals were constructed to drain water from the Lake Okeechobee agricultural area to the Everglades National Park. The canals, culverts and levees have changed from attenuated to pulsating flows, and the sustainability of the ecosystem has been subordinated to the minimization of flood risks during the hurricane season (June-October) and the storage of water during the dry season (November-May).[41]

The adverse impacts of the altered water flows on the National Park became apparent in the late 1960's. Congress initially tried to solve the problem by quantifying the Park's reserved water right. 1970 legislation[42] guaranteed the Park a 315,000 acre foot minimum flow. However, increased water diversion to Miami reduced flows needed in dry times, and the Park became a dumping ground for off-season regulatory releases during periods of abnormal winter rain. The net result remains a radically altered flow regime, which in turn interrupts the life cycles of many plant and animal species in the system. Seasonable drying and flooding cycles have been disrupted, and some areas have been deprived of a permanent surface water cover. For example, hardwood forests suffer from prolonged flooding, and Florida Bay experiences hypersalinity from reduced freshwater flows. Altered flow patterns along with other human encroachments are blamed for the large decline in wading bird populations.[43] In addition, when the water arrives in the Park it is loaded with phosphorus from agricultural runoff,[44] but the plants in the system are not adapted to such high nutrient levels.

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41. Stephen S. Light & J. Walter Dineen, *Water Control in the Everglades: A Historical Perspective, in* EVERGLADES: THE ECOSYSTEM AND ITS RESTORATION, *supra* note 40, at 47, 79.

42. River Basin Monetary Authorization and Miscellaneous Civil Works Amendments Act of 1970, Pub. L. No. 91-282, 84 Stat. 310 (1970).

43. G. Thomas Bancroft et al., *Relationships among Wading Bird Foraging Patterns, Colony Locations, and Hydrology in the Everglades, in* EVERGLADES: THE ECOSYSTEM AND ITS RESTORATION, *supra* note 40, at 615, 616.

44. Donald L. DeAngelis, *Synthesis: Spatial and Temporal Characteristics of the Environment, in* EVERGLADES: THE ECOSYSTEM AND ITS RESTORATION, *supra* note 40, at 307, 312.

What does it mean to "save" the Everglades? The current thinking is that the system must be restored. This is not a simple cessation of human encroachment. Rather, it involves the artificial reconstruction of the pristine state by sophisticated techniques such as computer hydrographs and the design of experimental management strategies that mimic the natural system to maintain a viable smaller ecosystem.[45] There is widespread agreement that more water must be put back in the system and that flows must be more continual for longer periods of time during the wet season to sustain the system during dry periods.[46] Experimental flows have been released but the results are still uncertain. Existing agricultural practices must be changed to decrease the amount of nutrients entering the system. All this must be done in conditions of substantial uncertainty about species and system responses to restoration efforts, and management strategies must be constantly evaluated and often revised.[47]

A. *Restoration is the Norm*

In the future, a major environmental management task will be the restoration of degraded ecosystems. Experiments are now underway on large and small river systems, wetlands and degraded landscapes to restore them to a baseline that reverses the most harmful effects of human use.[48] Restoration is a controversial strategy with many environmentalists because of their preference for natural solutions rather than artificial solutions, and the argument that "value increases as naturalness increases."[49] In an exploration of the consequences of the non-equilibrium paradigm, Professor Jonathan B.

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45. For a brief discussion of the recreation of simulated naturalness as a new management baseline, see NATIONAL RESEARCH COUNCIL, RIVER RESOURCE MANAGEMENT IN THE GRAND CANYON 46-48 (1996).

46. Carl J. Walters & Lance H. Gunderson, *A Screening of Water Policy Alternatives for Ecological Restoration in the Everglades*, *in* EVERGLADES: THE ECOSYSTEM AND ITS RESTORATION, *supra* note 40, at 757. The restoration of prior water levels will raise takings issues, an important issue not addressed in this paper. *See* Sharon S. Tisher, *Everglades Restoration: A Constitutional Takings Analysis*, 10 J. LAND USE & ENVTL. L. 1 (1994).

47. *See* Thomas T. Ankersen & Richard Hamann, *Ecosystem Management and the Everglades: A Legal and Institutional Analysis*, 11 J. LAND USE & ENVTL. L. 473, 493-96 (1996).

48. *See* NATIONAL RESEARCH COUNCIL, RESTORATION OF AQUATIC ECOSYSTEMS 15, 17 (1992).

49. Robert Elliot, *Extinction, Restoration, Naturalness*, 16 ENVTL. ETHICS 135, 143 (1994); *cf.* Alastair S. Gunn, *The Restoration of Species and Natural Environments*, 13 ENVTL. ETHICS 291 (1991); C. Mark Cowell, *Ecological Restoration and Environmental Ethics*, 15 ENVTL. ETHICS 19 (1993).

Wiener observes that the non-equilibrium paradigm led to resource protection strategies based on stasis and separatism.[50] The view "that human action is separate from nature and that the balance of nature is disturbed by human intrusion" leads either to the view that humans should dominate nature or "that human action represents desirable dominion over nature."[51]

B. *Adaptive Management: The End of Finality?*

The major institutional change necessitated by the non-equilibrium paradigm is the application of adaptive management to biodiversity protection. Students of organizational behavior have always counseled the need for feedback loops to reassess policy as new information accumulates, but this has never been taken seriously in environmental law and policy. Environmental policymakers favor management strategies based on the consistent application of fixed rules to yield a single, final decision — the rule of law. Environmental laws accept a scientific principle and then require its continued application regardless of subsequent research findings. For example, the Clean Water Act requires that all coastal sewage discharges receive secondary treatment, although there is considerable evidence that this may not always be necessary to achieve environmental objectives.[52] Adaptive management, in contrast, is premised on the assumption that management strategies should change in response to new scientific information: all resource management is an on-going experiment.

A recent National Research Council-National Academy of Sciences study captures the essence of adaptive management:

> Adaptive planning and management involve a decision-making process based on trial, monitoring and feedback. Rather than developing a fixed goal and an inflexible plan to achieve the goal, adaptive management recognizes the imperfect knowledge of interdependencies existing within

50. Jonathan B. Wiener, *Law and the New Ecology: Evolution, Categories, and Consequences*, 22 ECOLOGY L.Q. 325, 338-45 (1995) (reviewing JONATHAN WEINER, THE BEAK OF THE FINCH: A STORY OF EVOLUTION IN OUR TIME (1994)).

51. *Id.* at 340.

52. NATIONAL RESEARCH COUNCIL, MANAGING WASTEWATER IN COASTAL URBAN AREAS 32 (1993).

> and among natural and social systems, which requires plans to be modified as technical knowledge improves . . . .[53]

The idea that all management is an on-going experiment poses a profound challenge to our legal system because it undermines a core principle of procedural and substantive fairness — finality.[54] We follow Hume and Bentham and seek to confirm settled expectations unless there is a compelling, overriding reason, usually one grounded in constitutionally-protected norms such as free expression or racial equality. Once a decision is rendered, we expect parties to abide permanently by the outcome. Finality takes many forms. Sometimes it is represented by express doctrines and legislation, such as res judicata, statutes of limitation and the doctrine of vested rights. Other times finality is implicit. For example, the premise behind an environmental impact statement is that once environmental damage has been fully disclosed, a one-time decision on the merits of the activity is legitimate and final.

Adaptive management, of course, is simply public regulation and must satisfy constitutional requirements of substantive and procedural due process. A dynamic system will produce pressure for certainty. The United States Department of the Interior recently experienced this pressure in the Orange County Natural Communities Planning Process. To avoid listing a threatened song bird in southern California under state and federal endangered species acts, California passed the Natural Community Conservation Act in 1991. This statute provides a framework for voluntary local government and private landowner participation in the preparation of Natural Community Conservation Plans (NCCP) for the protection of those natural areas that provide habitat for a variety of rare and other species.[55] These

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53. *Id.* at 357.

54. For an insightful case study of the problems that adaptive management poses for "settled" management systems see John M. Volkman & Willis E. McConnaha, *Through a Glass, Darkly: Columbia River Salmon, The Endangered Species Act, and Adaptive Management*, 23 ENVTL. L. 1249 (1993).

55. CAL. FISH & GAME CODE § 2800-2840 (West 1984 & Supp. 1996). The statute authorizes any person or governmental agency to prepare an NCCP pursuant to an agreement with, and guidelines written by, the Department of Fish and Game. §§ 2810 & 2820. Each such plan is to promote "protection and perpetuation of natural wildlife diversity, while allowing compatible and appropriate development and growth." § 2805(a). Once the Department of Fish and Game approves an NCCP, the department may authorize developments that might otherwise be found to have an adverse impact on listed or candidate species if they are consistent with the NCCP. §§ 2081, 2825(c) & 2835.

plans are to be large scale, multi-species equivalents of existing Habitat Conservation Plans authorized under the federal Endangered Species Act (ESA).[56] To implement the NCCP program, the state resources agency selected as a pilot project the "coastal sage scrub" terrain of Southern California, a bioregion that had already experienced a number of troublesome conflicts under the existing endangered species legislation. The objective of the program was to allow the people with the most expertise to study and resolve conflicts at an early stage in the conservation process.

Instead of listing the threatened song bird, the Department of the Interior has issued a special rule under section 4(d) of the ESA which provides that any destruction of California Gnatcatcher habitat or actual killing of the bird will not be an illegal "take" under the ESA provided that the actions are consistent with local land use plans prepared pursuant to a state ecosystem protection planning act. Orange County is in the process of creating large reserves to protect the California Gnatcatcher and other listed and unlisted species, and landowners are concerned that the reserve system will be inadequate to protect future listed species.

To implement the pilot program, the agency selected a Scientific Review Panel of conservation biologists. The Panel's mission was to develop guidelines for a workable NCCP for the coastal sage scrub.[57] Much of the recent research on planning methodologies for habitat protection has concentrated on the design of "reserves," large areas managed to maintain or recreate natural habitat conditions.[58] These methodologies have been used for rare species, such as the desert tortoise and northern spotted owl, which occupied large areas of public land desired for uses inconsistent with habitat maintenance. For the coastal sage scrub, however, neither the federal nor the state government had allocated significant funds for habitat acquisition, and only a small proportion of the remaining habitat was located on public

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56. 16 U.S.C. § 1539(a) (1994).

57. *See, e.g.*, Peter F. Brussard, *The Role of Ecology in Biological Conservation*, 1 ECOLOGICAL APPLICATIONS 6 (1991); Michael E. Gilpin & Michael E. Soule, *Minimum Viable Populations: Processes of Species Extinction*, *in* CONSERVATION BIOLOGY: THE SCIENCE OF SCARCITY AND DIVERSITY 19 (Michael E. Soule ed., 1986); Reed F. Noss, *Protecting Natural Areas in Fragmented Landscapes*, 7 NAT. AREAS J. 2 (1987); John F. O'Leary & Walter E. Westman, *Regional Disturbance Effects on Herb Succession Patterns in Coastal Sage Scrub*, 15 J. OF BIOGEOGRAPHY 775 (1988).

58. *See, e.g.*, Dennis A. Albert, *Use of Landscape Ecosystems for Species Inventory and Conservation*, 10 ENDANGERED SPECIES UPDATE 20 (1993).

land. Although land acquisition authority is lacking, the statute does authorize the state to use permitting authority to enforce approved NCCPs.[59] The pilot program of local agencies and private coalitions aimed to prepare and implement NCCPs pursuant to the scientists' guidelines and to enforce them by consistency requirements.[60] In April 1996, the Orange County Board of Supervisors approved the first NCCP reserve, consisting of two subregional reserves with a combined total of 37,000 acres of protected multiple-species habitat and ecosystem types.

Since the ability of land owners to obtain immunity from future conservation efforts is the main incentive for land contributions, this new reserve system raises a major legal question: What happens if the reserve is considered insufficient to preserve a future listed species? In 1994 the Department of the Interior promulgated its Assurances or "No Surprises" policy, which promises that once a Habitat Conservation Plan is approved, no new reserve additions for subsequently listed species will be required except in extraordinary circumstances.[61] This policy tries to balance two fundamental principles. The first is that the sovereign cannot be estopped and thus cannot contract away the power to use the police power to respond to new circumstances that merit public action. The second is the desire to provide landowners with contractual assurances that once they make a deal with the government, it will be treated as a private contract. As further refined in the Orange County Implementing Agreement adopted by the county in April 1996, the Fish and Wildlife Service may still list additional species and issue 10(a) permits for them, but it promises to condition a 10(a) permit on the dedication of additional land only if alternative protection mechanisms, such as recovery plans,[62] have been exhausted, the additional land is neces-

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59. *See* CALIF. FISH & GAME CODE, §§ 2081, 2825(c), 2835 (West 1984 & Supp. 1996).

60. *See* DANIEL J. CURTIN, JR., CALIFORNIA LAND USE AND PLANNING LAW 26-28 (1994).

61. Office of the Secretary, Department of the Interior, News Release, Aug. 11, 1994, *available in* Westlaw, 1994 WL 440313. For the full test of the Joint FWS/NMFS No Surprises policy, see FISH & WILDLIFE SERVICE, DEPARTMENT OF THE INTERIOR, PRELIMINARY DRAFT HANDBOOK FOR HABITAT CONSERVATION PLANNING AND INCIDENTAL TAKE PERMIT PROCESSING app. 4 (1994).

62. Recovery plans, which include translocation of a species, are an increasingly used protection strategy. *See* Federico Cheever, *The Road to Recovery: A New Way of Thinking About the Endangered Species Act*, 23 ECOLOGY L.Q. 1 (1996). These plans may be mandatory when a species is at extreme risk and previous protection efforts have not succeeded. *See* Sierra Club v. Lujan, No. MO-91-CA-069, 1993 WL 151353 (W.D. Tex. Feb. 1, 1993).

sary to avoid jeopardy to the species[63] and the proposed additional mitigation measures are the least burdensome to the landowners. This policy, along with other incentives, should encourage more public and private participation in multiple-species protection plans because local land use plans define the substantive protection mandates.

C. *A New Regulatory Science: Conservation Biology*

Non-equilibrium ecology increases the pressure on science to produce socially useful research. Modern resource management requires the increased production of regulatory science. Regulatory science is scientific research directed toward providing useful information for regulators facing specific choices rather than pursuing knowledge for its own sake. The Department of the Interior's effort to create a National Biological Survey illustrates the focused and law-driven nature of regulatory science: "[o]ne of the most important uses of the scientific information gathered by the National Partnership [for Biological Survey] will be to assist decision-makers in addressing existing biological resource issues and anticipating future ones."[64]

Adherents to the non-equilibrium paradigm have pioneered a sophisticated new applied science, conservation biology, to protect ecosystems from human insults.[65] Conservation biology is a regulatory science that seeks to develop scientific criteria for regulatory standards used to develop on-the-ground management strategies.[66] The science has been stimulated by the need to match protected natural habitats with the survival of listed endangered and threatened species. For example, endangered species protection first requires the determination of an "effective population size" for species viability. After this is calculated, a habitat reserve system must be designed which takes into account existing land use patterns and uses. Existing laws and the politics of endangered species protection require only

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63. Implementation Agreement Regarding the Natural Community Conservation Plan for the Central/Coastal Orange County Subregion of the Coastal Sage Scrub Natural Community Conservation Program 100-102 (April 1996) (Copy on file with author).

64. NATIONAL RESEARCH COUNCIL, A BIOLOGICAL SURVEY FOR THE NATION 59 (1993).

65. The leading text is CONSERVATION BIOLOGY: AN EVOLUTIONARY-ECOLOGICAL PERSPECTIVE (Michael E. Soule & Bruce A. Wilcox eds., 1980).

66. *See* REED F. NOSS & ALLEN Y. COOPERRIDER, SAVING NATURE'S LEGACY: PROTECTING AND RESTORING BIODIVERSITY (1994); DEBORAH B. JENSEN, MARGARET S. TORN & JOHN HARTE, IN OUR HANDS: A STRATEGY FOR CONSERVING CALIFORNIA'S BIOLOGICAL DIVERSITY (1993).

that *minimum* necessary habitats be preserved. As a result, conservation biologists must be concerned with the relationship between habitat fragmentation and species extinction.[67]

D. *Uncertainty and the Non-Equilibrium Paradigm: Is There a "Junk Ecology" Problem?*

The experimental nature of the science of non-equilibrium ecology exacerbates the existing problem of making decisions in conditions of extreme uncertainty. An enduring problem in environmental law has been the inability of science to provide information that meets established standards of causation. The law has solved the uncertainty problem in several creative ways, such as the substitution of risk for cause-in-fact. The adaptability of these solutions to biodiversity protection has yet to be tested.

In the 1970's, the federal government began to enact laws to prevent unsafe levels of exposure to toxic chemicals through mandated risk assessments. When regulators and lawyers began to implement the National Environmental Policy Act, the Clean Air and Water Acts and other environmental statutes, they had to confront what scientists had always known: most environmental decisions must be made under conditions of extreme uncertainty. The regulated community seized on the pervasive uncertainty to argue that decisions should wait until "good science" provided conclusive evidence of harm. Environmentalists, led by the first Administrator of the Environmental Protection Agency (EPA), William Ruckleshaus, successfully established that a risk of future harm was a legitimate substitute for more traditional scientific and legal standards of cause and effect. Risk assessment calls for unavailable information and, thus, risk minimization legislation asked administrators to make decisions on the frontiers of science under extreme uncertainty. In the famous DDT controversy, cancer risk became a proxy for almost all environmental health risks. The net result is that the line between scientific inference and the more rigorous legal standard, proof of cause-in-fact, has been blurred in the regulatory arena.

The use of what are now known as risk assessment and risk management was also shielded from judicial review by two principles.

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67. For a good short review of the early literature, see Bruce A. Wilcox & Dennis D. Murphy, *Conservation Strategy: The Effects of Fragmentation on Extinction*, 125 AM. NATURALIST 879 (1985).

First, the New Deal-based principle of deference to expertise has been applied to scientific uncertainty, despite several efforts to develop a "hard look" theory of review of the scientific evidence. There continue to be occasional instances of the use of a "hard look" to invalidate risk assessments, primarily under the Occupational Health and Safety Act, which gives the Department of Labor less discretion compared to EPA to err on the side of risk minimization.[68] Second, the argument of scientists and engineers that risk assessments must err on the side of risk minimization by the incorporation of wide margins of safety has been widely endorsed by courts and has been carried over from toxic substances law to biodiversity protection.[69]

There is a counter-trend with substantial potential implications for non-equilibrium ecology. In 1993, the United States Supreme Court announced a new evidentiary standard in the so-called "junk science" case, *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[70] *Daubert* was one of many tort actions against the makers of the anti-morning sickness drug Bendectin, alleged to cause birth defects. The legal issue in *Daubert* was the standard for excluding scientific information in product liability litigation. The technical issue before the court was whether Rule 702 of the Federal Rules of Evidence adopted the *Frye* general acceptance test or, as many critics of the *Frye* test had urged, a more liberal standard for admissibility, which would not make general acceptance of a scientific theory a necessary condition for admissibility. Under the Federal Rules of Evidence, scientific testimony is admissible if it pertains to "scientific . . . knowledge."

Daubert unanimously held that Rule 702 superseded the "austere" Frye test. The Federal Rules require only that the scientific evidence be both relevant and reliable, and thus trial judges have an obligation to apply the methods and procedures of science to screen the reliability of all scientific evidence. "In a case involving scientific evidence, evidentiary reliability will be based on scientific validity," defined as knowledge grounded in the methods and procedures of science. *Daubert* has become the Magna Carta of the good science versus bad science argument.

Ironically, the Supreme Court's honest effort to use the scientific method to develop rules to control the admissibility of scientific

68. *See, e.g.*, AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir. 1992).
69. *See, e.g.*, City of Las Vegas v. Lujan, 891 F.2d 927 (D.C. Cir. 1989).
70. 509 U.S. 579 (1994).

evidence may unduly constrain the use of science to improve environmental regulation. *Daubert* suggests that fairness requires a uniform definition of good science for all science-based decisions. It fails to realize that legal responsibility is a continuum. Naturally, standards of proof for cause are highest when an individual is accused of a crime. The standard is lower when the issue is civil liability because money, not human life or freedom, is at stake. The standard should be less for public health-based regulation because regulatory liability is often a form of tax imposed on those who directly profit from harmful acitivites and the "tax" is partially spread to larger segments of the population through the market. To sustain legitimate government functions, we have relaxed the necessity to show a causal link between the regulation and the production of public benefits and required only that the government action be rational. The application of science-based regulation to new problems is an experiment. Government agencies should be entitled to considerable, but not unlimited discretion, to use new, not completely accepted science to justify the rationality of the regulation as long as the regulations incorporate new knowledge and modify the regulation accordingly.

Post-*Daubert* toxic tort cases illustrate the continued resistance of public law models for private adjudication. Courts are now much less willing to substitute risk assessments for traditional scientific evidence, and there is a growing movement to reduce the use of risk assessment in public regulation by moving toward the private tort standards of cause-in-fact.[71] The case for carrying the private law model to public regulation is the superficial similarity of cause-in-fact as it is used by scientists and lawyers in both regulation and private adjudication. Ultimately, however, the similarity is superficial because different values are at stake in each process. Private adjudication links responsibility and liability and the restrictive concept of cause-in-fact is grounded in notions of fundamental fairness common to all major legal systems. Fairness, of course, is a major constraint on all regulation, but science-based regulation must be grounded in the experimental and skeptical philosophy of modern science. The search for causal relationships is a constant process of testing and retesting. In contrast, legal cause is a one-time conclusion to be reached for the purpose of determining responsibility for a harmful activity, a crime, an accident, or damages that result from exposure to a risk. The legal

71. *See* David A. Wirth & Ellen Silbergeld, *Risky Reform*, 95 COLUM. L. REV. 1857 (1995) (book review).

model of cause, particularly as applied to biodiversity protection, constantly asks scientists to answer questions that they are not prepared to answer with the confidence level that the law requires.[72] The use of science-based regulation therefore requires more tolerance for uncertainty than does the civil and criminal law.[73]

Two pre-*Daubert* examples of the restrictive use of science, which partially anticipate the Supreme Court's new admissibility standard, illustrate the potential use of *Daubert* to undermine risk-based biodiversity protection regulation. In the Agent Orange litigation, *In re Agent Orange Products Liability Litigation*,[74] a respected federal trial judge announced that "sound epidemiological studies . . . are the only useful studies that have any bearing on causation."[75] *Daubert* could similarly preclude the use of evidence generated by the new applied science of conservation biology which is being used to design nature reserves to protect endangered species. One of *Daubert's* proposed guidelines for the reliability of scientific evidence is the falsifiability of the hypothesis on which the scientific conclusion is based. In designing nature reserves based on conservation biology, however, it is difficult to meet this standard. As two leading conservation biologists involved in the initial design of Northern Spotted Owl reserves observe, reserve design is based on population models supported "by inferences drawn from research results and hypotheses not falsified by specific tests."[76] In the initial stages of the application of conservation biology, only general hypotheses may be falsified. Specific decisions will be based on the application of models; testing and falsifiability can only come later. In addition, the *Daubert* test is hostile toward applied or regulatory science as opposed to "pure" or theoretical science, particularly science done for the courtroom. Because much conservation biology research is site-

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72. *See* CARL F. CRANOR, REGULATING TOXIC SUBSTANCES: A PHILOSOPHY OF SCIENCE AND THE LAW 7, 12 (1993).

73. EPA's Proposed Guidelines for Ecological Risk Assessment, 61 Fed. Reg. 47522, 47600 (1996) (notice of availability and opportunity to comment issued Sept. 9, 1996) [hereinafter Proposed Risk Assessment Guidelines] (lists the "strength of cause/effect relationships" as one of several relevant lines of evidence to support the confidence of ecological risk assessments).

74. 611 F. Supp. 1223 (E.D.N.Y. 1985), *aff'd*, 818 F.2d 187 (2d Cir. 1987), *cert. denied sub nom.* Lombardi v. Dow Chemical Co., 487 U.S. 1234 (1988).

75. *Id.* at 1231.

76. Dennis D. Murphy & Barry R. Noon, *Integrating Scientific Methods With Habitat Conservation Planning: Reserve Design for Northern Spotted Owls*, 2 ECOLOGICAL APPLICATIONS 3, 15 (1992).

specific and conducted to support a specific regulatory program, it could be classified as litigation research as opposed to pre-litigation research and thus considered unreliable.

Daubert's application to biodiversity is unclear, in part because the issues are presented to the court as the prior exercise of administrative discretion. The first federal court of appeals decision to deal with the application of *Daubert* to biodiversity preservation considered and rejected both the argument that *Daubert* mandates the use of conservation biology and the proposition that the United States Forest Service has a statutory duty to use its forest management authority to create biodiversity reserves.[77] The issue was whether the United States Forest Service had a duty to use conservation biology principles as opposed to population viability analyses in forest management plans in two growth forests in northern Wisconsin. The court reasoned that "[w]hile such a proposal might assure better documentation of an agency's scientific decisions, we think that forcing an agency to make such a showing as a general rule is intrusive, undeferential, and not required."[78] The court's deference to agency science is not surprising. However, its willingness to entertain sophisticated arguments about the nature of scientific methods suggests that *Daubert* could have a profound and chilling influence on the admission of evidence relevant to environmental preservation that is not grounded in the traditional scientific method, such as risk assessment. Risk-based ecological judgments will increase in the future. EPA has endorsed the concept and issued Proposed Guidelines for Ecological Risk Assessment in September of 1996.[79]

The potential problem is that courts will never understand science except in terms of causal chains.[80] *Daubert's* reliance on the search for a scientifically valid approach to justify legal decisions rests on three crucial but dubious assumptions about the way science is used to establish environmental standards. As scientific as the opinion purports to be, *Daubert* is based on a narrow and distorted view of how science is performed and ultimately holds science to unreasonably high performance standards.[81] First, it assumes that objective

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77. *See* Sierra Club v. Marita, 46 F.3d 606, 621-22 (7th Cir. 1995).

78. *Id.* at 622.

79. Proposed Risk Assessment Guidelines, *supra* note 73, at 47552.

80. *See* Troyen A. Brennan, *Causal Chains and Statistical Links: The Role of Scientific Uncertainty in Hazardous-Substance Litigation,* 73 CORNELL L. REV. 469 (1988).

81. Many types of natural resources regulation are based on models. For example, due to the geological complexity of aquifers, ground water regulation and pollution liability is often

scientific truth exists. Second, it assumes that new science is bad science. Third, it assumes that science must be held accountable to the state, either by lay judicial or administrative scrutiny of the scientific bases of regulations. The first two assumptions are too simplistic to serve as bases for limiting environmental regulation. For better or worse, knowledge is contingent and experimental. Thus, new science is not inherently good or bad: it is just science.

The third assumption reflects more legitimate values and merits a more extended examination. The use of science to support public health and biodiversity regulation would seem to be a prime candidate for public scrutiny; the economic consequences of the alternative resource allocations suggested by science are often substantial. However, the Court's control approach ultimately reflects a static view of science which could overly restrict the necessary use of scientific evidence. Environmental science is evolving as a special branch of science, regulatory science. Regulatory science is an applied as opposed to theoretical science, although the line is becoming increasingly blurred. Regulatory science is driven by policy questions from public officials rather than by research agendas set by individual scientists. Often environmental regulations require scientists to answer questions that they consider to be non-scientific or that are posed in a form different from that typically associated with traditional scientific research in advance of the completion of a research agenda. Thus, prior research data and research designs are generally not adequate to answer the questions posed by legislation. In addition, disciplinary boundaries must be scrambled so that data can be integrated. The source of the tension is that scientists are asked to answer questions that are not classically "scientific" before ample experiments are completed. Based, as it is, on probabilistic science, the non-equilibrium paradigm is simply another example of the pervasive problem of scientific uncertainty. However, the time-horizons involved in the application of the non-equilibrium paradigm to resource management intensify the existing uncertainty problems and make it more difficult to employ the strategies that we have used

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based on mathematical models. But, models are by definition a partial and evolving representation of reality. *Daubert* appears to require that they be validated, but many hydrologists doubt whether this is possible and, *more importantly*, whether the failure to validate a model in any way diminishes its utility and legitimacy. *See* Maryann Wasiolek, Groundwater Flow Models as Scientific Evidence, Paper Presented at Dividing the Waters III: A Conference for Judges & Masters Involved in Western General Stream Adjudications (May 1-4, 1996), *in* RESOURCE BOOK: DIVIDING THE WATERS III (1996).

to navigate around the constraints on environmental management raised by uncertainty. In short, environmental science is too uncertain to constrain environmental regulation and management.

II. TOWARD A NEW ENVIRONMENTAL ETHIC

Environmentalism and environmental law are in a period of profound transition as the scientific landscape changes from a simple, linear landscape to a complex, stochastic one. To balance the legal system's traditional promotion of individual fairness with the continued protection of the environment, environmental law must adapt, in part, by utilizing concepts which provide for the continuous integration of science into policy-making. The legitimacy of any theory that seeks to prescribe human behavior depends upon the following four conditions:

1. *The theory must be grounded in comprehensible rationality.* It must be able to explain why human behavior is limited, reoriented and sanctioned. This condition finds a stronger basis in East Asian culture than in Western culture.

2. *It must permit progressive discourse.* This requires the power to engage diverse communities in the debate and provide common norms against which alternative arguments can be evaluated.

3. *It must permit choice.* Its principles should permit us to make choices among options.[82]

4. *It must be able to adapt to new knowledge.* The major defect in existing regulation is that it seeks permanence.

A. *The Futile Search for Categorial Imperatives*

Initially, these four conditions suggest a constraint on environmental discourse that has been ignored or explicitly rejected by many proponents of environmentalism. Difficult as it is to accomplish, the legitimacy of environmental protection must be rooted in norms of Western culture such as rationality, science and private property[83]

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82. As Farber and Hemmersbaugh have expressed this condition, "[f]rom the vantage point of our (possibly imaginary) thoughtful policymaker, workability is more crucial than theoretical rigor." Daniel A. Farber & Paul A. Hemmersbaugh, *The Shadow of the Future: Discount Rates, Later Generations, and the Environment*, 46 VAND. L. REV. 267, 271 (1993).

83. The tension between private property rights and environmentalism is explored in Joseph L. Sax, *Property Rights and the Economy of Nature: Understanding Lucas v. South*

because alternative theories of the primacy of nature degenerate into incoherence, primatism and fascism.[84] This proposition rejects the two central arguments behind non-anthropocentric environmental ethics: (1) that environmentalism represents the progressive extension of fundamental rights from humans to non-humans, and (2) that East Asian philosophy and religion, based on a non-dualistic view of humans and nature, offer promising alternatives. East Asian philosophy and religion is an environmental dead-end[85] so the real issue is whether it is possible to construct a post-modern environmental ethic from the Western philosophical tradition.

Many in the environmental community have sought to establish neo-Kantian ethics,[86] although Kant's philosophy provides no support for non-anthropocentric ethics.[87] Kant initially tried to develop a rational approach to moral judgment, but instead ultimately developed his moral theory of the categorical imperative. The categorical imperative states that an act is moral not for what it produces but because it is consistent with some prior universal principle.[88] Kant tried to state an alternative to moral intuitiveness

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Carolina Coastal Council, 45 STAN. L. REV. 1433 (1993), and Fred Bosselman, *Four Land Ethics: Order, Reform, Responsibility, Opportunity*, 24 ENVTL. L. 1439 (1994).

84. FERRY, *supra* note 30, at 92-94.

85. Environmentalists have identified the Western tradition, either the Judeo-Christian religious heritage or the Greco-Enlightenment one, as the source of environmental degradation. The central premise of these traditions is the duality between man and nature. No such duality exists in Taoism which has been identified as an environmental ethic because it teaches that one should live in harmony with natural cycles. The well-known yin-yang (active-passive / masculine-feminine) polarity is one manifestation of the non-duality between man and nature. Thus, unlike the Western tradition, stemming from Plato's theory that matter was a plastic feminine form substance upon which order should be imposed, order is not imposed but "arises from the mutual adjustment of the many natural forces." CALLICOTT, *supra* note 26, at 70. The problem with the variety of East Asian traditions is that they contain no effective theory to restrain human manipulation of nature because they accept manipulation as natural. Confucianism is humanistic to the core and thus human intervention is the norm and the Japanese Buddhist love of nature is a love for the transformation of the imperfect into the perfect — the bonsai or the garden — i.e. a selective love of nature.

86. *See, e.g.*, EDITH WEISS, IN FAIRNESS TO FUTURE GENERATIONS: INTERNATIONAL LAW, COMMON PATRIMONY, AND INTERGENERATIONAL EQUITY 1-93 (1989).

87. Ferry argues that Kant concluded that "man is an antinatural being, a being who lives by law [and] this, in fact, . . . prohibits . . . the Kantian tradition . . . from identifying with radical ecology." FERRY, *supra* note 30, at 54.

88. Kant developed his theory that morality procedes from prior principles in his masterwork, IMMANUEL KANT, CRITIQUE OF PURE REASON, (J.M.D. Meiklejohn trans., rev. ed. 1943). There are many commentaries of Kant's theory of the categorical imperative. I have relied on NORMAN KEMP SMITH, A COMMENTARY ON KANT'S "CRITIQUE OF PURE REASON" 570-76 (1984).

starting from the idea that since we are all autonomous agents, we must act with impartiality. This led him to argue that moral law applies without distinction to persons and that all persons must be presumed entitled to equal rights. The most extreme extension of Kantian ethics has been to include the entire planet within a moral sphere.[89] This leads to the conclusion that all living and *non-living* forms, with the exception of humans, have a superior right to exist and, thus, humanity must self-destruct. Less extreme forms of this movement accord equal or partial rights to fauna but not flora. Thus, as Deep Ecology preaches, our lives need to be adjusted to respect and protect non-human communities.[90] These theories originated in the Romantic reaction to the end product of the Enlightenment, the French Revolution. The neo-paganism strain of the Enlightenment and Romantic movement lives on in the environmental movement and co-exists uneasily with "rational discourse." Both strains are captured in Leopold's Kantian land ethic — let nature be.

Advocates of post-modern ethics have constructed an environmental ethic outside the Western philosophical tradition by collapsing Hume's distinction between fact and value, or is and ought,[91] and asserting that we can derive objective value from fact. Ecosystems are said to be stable, and if this is true, the moral value of diversity can follow. Kant, as did Hobbes and Locke, defined morals with respect to a community, and post-modern environmental ethics builds on this foundation to extend these communities to include ecosystems. However, the argument for including ecosystems is hopelessly complicated because it basically posits that nature appreciation is instinctual. Post-modern ethicists nonetheless suggest that the appreciation of nature's multiple functions will lead to self-transcendence,[92] and this experience can lead to the formation of new values. This, combined with the classic tradition of altruism, leads to the

89. J. Baird Callicott describes the thrust of post-modern environmental ethics as an approach which makes "the effects of human actions on individual nonhuman natural entities and on nature as a whole directly accountable . . . ." CALLICOTT, *supra* note 26, at 10.

90. For a good summary of the movement, see Arne Naess, *Deep Ecology Movement: Some Philosophical Aspects*, 8 PHILOSOPHICAL INQUIRY 10 (1986), *reprinted in* THE ETHICS OF THE ENVIRONMENT, *supra* note 29, at 162.

91. For an important modern discussion of this distinction see ROBERT NOZICK, PHILOSPHICAL EXPLANATIONS 535-51, 567-70 (1981).

92. *See* Ernest Partridge, *Nature As a Moral Resource*, 6 ENVTL. ETHICS 101 (1984).

conclusion that one's highest achievements are within an expanded moral community.[93]

The efforts to include ecosystems within the moral community have largely failed because placing humans and living and non-living nature on an equal moral footing precludes rational choice.[94] As I have previously argued, the search for a single universal ethic to reverse the traditional human-nature relationship has proved futile. For example, in his widely influential meditation on environmental ethics, EARTH AND OTHER ETHICS, Christopher Stone concludes that we cannot recognize absolute rights of nature qua nature to exist regardless of the human impacts of the recognition of such rights.[95] Rather, we can only have weaker "moral considerations" based on non-individualistic attitudinal idealism — the subordination of human desires based on our heightened understanding of costs that acting on our desires imposes over space and time.[96] This echoes the conclusion of philosophers such as Bryan Norton, who continue to object to any intrinsic theory because such theories preclude the necessary weighing of interests needed to solve resource-use conflicts.[97] One of the most forceful and widely read advocates of the ethical basis of environmentalism is the recycled philosopher Mark Sagoff. Unlike most lawyers and environmental philosophers, Sagoff has intensively

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93. Seductive as they are, appeals to community must always be viewed with skepticism. R. NISBET, THE QUEST FOR COMMUNITY: A STUDY IN THE ETHICS OF ORDER AND FREEDOM (1951) reminds us that the Western tradition venerates rationalist individualism which, following KARL R. POPPER, THE OPEN SOCIETY AND ITS ENEMIES (5th ed. 1971), is defined as a breaking away from the bounds of culture. The first meaning of community is the cultural community, which is characterized by the hierarchy and order of Christian Europe. The other meaning of community is the political community which is traced from Plato to Rousseau. Rousseau's argument was that conformity to the "general will" will produce a reign of virtue. If the individual freed himself from all other structures and bound himself to the all-powerful political state, there would be a humanitarian redemption. This led to the Reign of Terror in the French Revolution and to the ideas of radical equality and concentrated state power. The idea of the total community supported by mass participation and allegiance led to Napoleon, Marxism and finally Nazism, in short the totally evil but rational state. The tension between environmentalism and authoritarianism was first explored in WILLIAM OPHULS, ECOLOGY AND THE POLITICS OF SCARCITY (1977), revised as WILLIAM OPHULS & A. STEPHEN BOYAN, JR., ECOLOGY AND THE POLITICS OF SCARCITY REVISITED: THE UNRAVELING OF THE AMERICAN DREAM (1992).

94. STONE, *supra* note 7.

95. STONE, *supra* note 7.

96. *Id.* at 132-141.

97. *See* Bryan G. Norton, *Change, Constancy, and Creativity: The New Ecology and Some Old Problems*, *supra* pp. 49-70.

studied the theory, application and philosophy of ecology[98] and he has directly confronted the choice between science and ethics. In a 1992 article, he traced the history of wetlands protection, arguing that the early scientific justifications for wetland protection have been refuted and concluded that "[c]hanging values not changing knowledge motivate and justify efforts to preserve wetlands."[99] My dispute with his reading of history is two-fold: (1) it substitutes a dichotomy for a complex evolution process between changing public perceptions of worth and science[100] and (2) the survival of ethical justifications unsupported by science is an open question.

B. *A New, Science-Based Environmental Ethic*

There is a close and evolving link between science and ethics, but the relationship is more contingent and open than most environmentalists assume. The symbiotic relationship between new information and public perception of the value of resources does make it difficult, if not impossible, to separate fact from value, just as modern administrative law recognizes that fact and law are intertwined.[101] The modern dichotomy between fact and value[102] is overdrawn, although not to the point of collapse.[103] Hume never rejected the idea that one can derive the consequences of an action from fact; he only insisted that the ultimate decision to act on the facts results from the attribution of moral significance to them. E. O. Wilson articulat-

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98. *See* MARK SAGOFF, THE ECONOMY OF THE EARTH: PHILOSOPHY, LAW, AND THE ENVIRONMENT (1988).

99. Mark Sagoff, *Settling America or the Concept of Place in Environmental Ethics*, 12 J. ENERGY NAT. RESOURCES & ENVT'L L. 349, 379 (1992).

100. The preferred term for wetland value is now wetland function, and scientific research continues to demonstrate that wetlands perform a variety of important functions. *See* NATIONAL RESEARCH COUNCIL, WETLANDS: CHARACTERISTICS AND BOUNDARIES (1995).

101. For a recent articulation of the intertwinement (arguing, as do I, that the two should not be artificially separated) see Hannu Tapani Klami et al., *Evidence and Legal Reasoning: On the Intertwinement of the Probable and the Reasonable*, 10 LAW & PHILOSOPHY 73 (1991).

102. In this century, this position has been associated with logical positivism and British empiricism, which have dominated philosophy in the English speaking and Scandinavian countries. Logical positivism asserts that propositions have no meaning unless they can be verified and are closely linked to the main currents of twentieth century science. John Passmore, *Logical Positivism, in* 5 THE ENCYCLOPEDIA OF PHILOSOPHY 52 (1967).

103. For a concise articulation of the need to maintain the distinction between fact and value in spite of the recognition that facts spell out consequences to be avoided, see CHARLES C. MANN & MARK L. PLUMMER, NOAH'S CHOICE: THE FUTURE OF ENDANGERED SPECIES 204-208 (1995).

ed the concept that science is a source of wisdom: "For what, in the final analysis, is morality but the command of conscience seasoned by rational examination of the consequences."[104] My quarrel with existing theories of nature ethics that urge a complete collapse of the dichotomy between fact and value is that they do not permit an evolving dialogue between "commands of conscience" and the accumulation of evidence about the consequences of the command. Some degree of collapse is necessary to develop new resource management principles, but I apply the collapse in a more cautionary way than have the proponents of the rights of nature.

Ethics are not a substitute for scientific analysis, and thus environmental law and environmentalism are more contingent than many would prefer them to be. Any principles derived from science remain subject to revision in light of new evidence. Ethics can legitimately, however, bridge the gap between scientific uncertainty and the risks of inaction pending further research through the adoption of the cautionary principle. Environmentalism does represent a profound shift in our world-view of our physical surroundings.[105] Through science we have increasingly come to see natural processes as phenomena to be respected rather than manipulated. This new-found respect can support laws, enacted in advance of conclusive scientific evidence, which recognize the value of new resource functions. This is the thrust of the newly-emerging precautionary principle in international law.[106] However, as long as we value rationality (an open question with respect to some strains of modern environmentalism), science will continue to serve an important checking function. The need for some scientific justification, however probabilistic, for environmental regulation is necessary to

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104. WILSON, *supra* note 38, at 351.

105. Professor Eric Freyfogle argues that our changed moral understanding of the natural order "now going on is one of the most profound changes in human history." Eric T. Freyfogle, *The Moral Psychology of the Environmental Age*, *in* ENVIRONMENTAL POLICY WITH POLITICAL AND ECONOMIC INTEGRATION: THE EUROPEAN UNION AND THE UNITED STATES 35 (John Braden et al. eds., 1996).

106. The precautionary principle is that international law version of the familiar United States "margin of safety" standard which allows regulators to err on the side of public health and safety. The idea is novel in international law where law is made by consensus and thus tends toward the lowest common denominator. However, there is a movement in international environmental law to shift from post-disaster remedies to prevention. *See* Alexandre S. Timoshenko, *Ecological Security: Response to Global Challenges*, *in* ENVIRONMENTAL CHANGE AND INTERNATIONAL LAW 413 (Edith B. Weiss ed., 1992); HARALD HOHMANN, PRECAUTIONARY LEGAL DUTIES AND PRINCIPLES OF MODERN INTERNATIONAL ENVIRONMENTAL LAW (1994).

constrain the potential arbitrariness and unfairness that can result from the substitution of intuition for verification.[107]

Science can lead to what has been called ecological rationality, a transformation in our way of thinking. Principles remain open to change in light of scientific evidence. One of the leading pioneers of environmental ethics concludes that to develop a new global ethic, "science can help provide a clearer vision" compared to "any pre-scientific, mythological way of valuing nature."[108] We need regulatory processes that have two features commonly lacking in existing ones. First, we need phased processes that allow for progressive stages of regulations based on current knowledge. Lawrence E. Susskind has argued that international environmental law should be formed through agreements that define "contingent actions that come into force if certain events occurred or thresholds were passed."[109] Second, we need feedback mechanisms to allow midcourse corrections. Instead of viewing regulatory decisions as one-time fixed decisions, we need mechanisms that allow decision makers to reassess the regulation in light of new scientific information. As Professor Jonathan Wiener has argued, "We need to move from an environmental law based in a paradigm of a stable equilibrium — a policy mismatch in light of the new ecology — to an environmental law that welcomes change and cares about consequences rather than categories."[110]

The new science of ecosystem management can also be informed by the adoption of an ethical obligation to the expanded community of future generations. The underlying philosophical principle of much environmental management is the duty of inter-generational equity.[111] The basic idea is that "[w]e as a species, hold the natural and

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107. Freyfogle, *supra* note 105, examines five challenges to utilitarian or anthropocentric environmentalism posed by advocates of the rights of the nature. These challenges include the argument that utilitarian calculations are impossible to make according to their own terms and the need to substitute intuition for empiricism.

108. Holmes Rolston, III, *Science-Based Versus Traditional Ethics, in* ETHICS OF ENVIRONMENT AND DEVELOPMENT: GLOBAL CHALLENGE AND INTERNATIONAL RESPONSE 64, 71-72 (J. Ronald Engel & Joan G. Engel eds., 1990). Donald Worster has also rejected neopaganism in favor of "the superiority of science over superstitition." DONALD WORSTER, THE WEALTH OF NATURE 218 (1993).

109. SUSSKIND, *supra* note 9, at 80-81.

110. Wiener, *supra* note 50, at 334.

111. Weiss argues that present generations owe conservation duties to future generations and that "[c]onservation of quality . . . cautions against water withdrawals that may result in pollution of water supplies . . . that will be expensive or impossible for future genera-

cultural environment of our planet, both with members of the present generation and with other generations, past and future."[112] This principle has been rapidly adopted as the ethical norm against which major international agreements and mandates must be tested. The precise contours of intergenerational duties are not self-defining, but the core idea is that each generation has a duty to manage its common patrimony for the benefit of the next generation. This theory of an expanded human community is consistent with the non-equilibrium paradigm because it rejects both the prevailing ethic that resources should be immediately consumed because their future value is likely to decrease, and more radical ecological visions of the restoration and maintenance of pre-human environments. Inter-generational equity incorporates a precautionary principle that is open to modification in light of new information.

III. CONCLUSION

The central project of environmental law has been to marry wonder to power. Environmentalism's central insight has been to demonstrate the need to supplant the Enlightenment view that humans are sovereign over nature with one which appreciates the many instrumental as well as intrinsic values of nature. In short, nature is both a commodity and a source of delight and wonder to be valued by different standards from the past. Environmental law's mission has been to counter the traditional bias in favor of the early and rapid exploitation of nature by using principles and procedures which try to sustain biodiversity over time. To many environmental-ists this seems a modest if not incorrect objective, but it is Herculean in light of the continued dominance of the view that nature is a commodity for present consumption. The principal argument of this paper is that if environmental law is to succeed in this effort, there is no escape from the development of a science-based management. Biodiversity management can be informed by values which reflect the heightened appreciation of the functions that natural systems perform, but the management choices that are made must be grounded in science and recognized as contingent. Modification of mangement strategies and adjustment to new information, not the recognition of the rights of nature, will characterize the future of environmental law.

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tions to repair." WEISS, *supra* note 86, at 238.

112. *Id.* at 17.