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Slouching Toward Eden: The Eco-Pragmatic Challenges of Ecosystem Revival, in Symposium, The Pragmatic Ecologist: Environmental Protection as Jurisdynamic Experience

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Slouching Toward Eden: The Eco-pragmatic Challenges of Ecosystem Revival

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INTRODUCTION

Ecosystem revival represents a radical departure from past environmental paradigms. This new paradigm is riddled with unarticulated and inconsistent assumptions. The structure of environmental law and the culture of the agencies that implement it are based on either the preservation of an undisturbed nature devoid of humans or pollution control rather than ecosystem management. We look for quick, technological fixes to mitigate the worst adverse environmental impacts of activities rather than the sustained management of functioning ecosystems. This Article explores some of the underlying scientific and legal problems that are raised by the many ecosystem revival efforts underway throughout the world in an effort to articulate and minimize such difficulties.

I. FROM NATURE PRESERVATION TO ECOSYSTEM REVIVAL

A. OUR CHANGED VIEW OF NATURE

The revival of degraded ecosystems is a major focus of

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second generation environmental law and policy.[1] This reflects the fact that environmentalism is a young but rapidly evolving movement that is both the product of advances in scientific understanding of the consequences of human modification of natural systems and potentially profound changes in societal values.[2] Environmentalism has derived much of its legitimacy from an imperfect understanding of ecology.[3] At the dawn of the modern environmental movement in the late 1960s, ecology seemed to reinforce the increasingly widespread belief that society should preserve as much "nature" as possible from human degradation.[4] Environmental policy, however, is much more complicated than we initially assumed. Nature preservation is an example of the maddening complexity of second generation environmental policy. The simple idea that "untrammeled"[5] nature is both morally and scientifically superior to the modified landscape has now morphed into the ambitious but extremely ambiguous argument that we should conserve biodiversity—the complex, continuing process of species and ecosystem evolution—to the maximum extent possible.[6]

The teaching of biodiversity conservation and the applied science that it has spawned, conservation biology, have fundamentally changed our view of nature preservation. Consistent with postmodern philosophy, which views all ideas as social constructs, we understand that "[t]he very concept [of] . . . environmental problems . . . refers to a normative state of nature."[7] Most scientists have rejected, as impractical and

1. Gilbert F. White, *Reflections on Changing Perceptions of the Earth*, 19 ANN. REV. ENERGY & ENV'T 1, 8 (1994).

2. *See id.* at 2 (articulating the stages of this value shift).

3. A second major source of legitimacy in environmental law is the hypothesis, popular in occupational medicine, that exposure to toxic substances creates a serious risk of cancer. *See* ROBERT N. PROCTOR, CANCER WARS: HOW POLITICS SHAPES WHAT WE KNOW AND DON'T KNOW ABOUT CANCER 1 (1995) (reviewing oncological theories ranging from environmental exposure to genetic predisposition and describing their influence on the legitimacy of environmental regulation).

4. *See* RODERICK FRAZIER NASH, WILDERNESS & THE AMERICAN MIND 368 (4th ed. 2001).

5. This term is taken from the definition of "wilderness" in the Wilderness Act of 1964. 16 U.S.C. § 1131(c) (2000).

6. EDWARD O. WILSON, THE DIVERSITY OF LIFE 312 (1992).

7. *See* Elizabeth Ann R. Bird, *The Social Construction of Nature: Theoretical Approaches to the History of Environmental Problems*, ENVTL. REV., Winter 1987, at 255, 260.

unsound, the romantic idea that nature is, and should forever be, a place without humans. In much of the world, there are few places where undisturbed nature exists. Moreover, much of what we thought was undisturbed nature had in fact been substantially modified by aboriginal peoples prior to European contact.[8] Modern ecology counsels that the future focus of environmental protection should be on the revival and adaptive management of previously degraded ecosystems. It also tells us that we must take landscapes as we find them, including human interlopers.[9] As a result, modern ecology and environmental management are returning to the problem posed by Genesis: How should one manage the Garden of Eden after it has been populated and degraded by humans?[10]

B. REVIVAL VERSUS RESTORATION

The problems of returning to the Garden of the Eden are manifold, starting with terminology. Ecosystem restoration is the more common term,[11] but its accepted meaning is too narrow to describe the thousands of large and small ecosystem improvement efforts and to describe other improvement options.[12] A major 1992 report by a National Academy of

8. The question of the extent to which Native Americans modified the landscape is the subject of lively recent historical debate. *See* TIM FLANNERY, THE ETERNAL FRONTIER: AN ECO-HISTORY OF NORTH AMERICA AND ITS PEOPLES 194 (2001); SHEPARD H. KETCH, THE ECOLOGICAL INDIAN: MYTH AND HISTORY 22 (1999); *see also* TED STEINBERG, DOWN TO EARTH: NATURE'S ROLE IN AMERICAN HISTORY 11 (2002).

9. Consistent with this understanding, modern ecology views humans not as alien, exotic species to be eliminated to the maximum extent possible, but as important ecosystem actors. Many environmentalists, however, find this idea disturbing because it will promote ecosystem degradation. *See, e.g.*, Oliver A. Houck, *Are Humans Part of Ecosystems?*, 28 ENVTL. L. 1, 11 (1998) (stating that humans are part of ecosystems but are not their measure).

10. 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.*, J. BAIRD CALLICOTT, EARTH'S INSIGHTS 14-43 (1994); *cf.* Judith M. Green, *Retrieving the Human Place in Nature*, 17 ENVTL. ETHICS 381, 389-93 (1995) (recounting the influence of Western beliefs on ecology). For a lucid discussion of the response of Judeo-Christian-Enlightenment thought to the problems posed by the Genesis narratives of a complete, earthly paradise and the reality of human exploitation of the earth, see JOHN PASSMORE, MAN'S RESPONSIBILITY FOR NATURE 7-27 (1974).

11. The leading journal is *Restoration Ecology*.

12. Professor Alyson C. Flournoy has proposed a broader, medically derived definition to address the limitations of the term. Alyson C. Flournoy, *Restoration Rx: An Evaluation and Prescription*, 42 ARIZ. L. REV. 187 (2000). She would define restoration as a return to a healthy and vigorous state. *Id.*

Sciences Committee[13] defined restoration as "the return of an ecosystem to a close approximation of its condition prior to disturbance."[14] This definition distinguishes restoration from other improvements such as creation, reclamation, and rehabilitation because only restoration is a holistic process rather than "the isolated manipulation of individual elements."[15] The report also distinguished restoration from mitigation, which it dismissed as "simply the alleviating of any or all detrimental effects arising from a given action" as well as from preservation.[16] This Article uses the term ecosystem revival instead of restoration because it encompasses all efforts to improve degraded ecosystems that may fall short of returning to the "original." The term "revival" avoids difficult,

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at 188. For a brief but insightful analysis of the problems of following the strict definition of restoration, see Max Oelschlaeger, *The Politics of Wilderness Preservation and Ecological Restoration*, 42 NAT. RESOURCES J. 235, 237-39 (2002).

13. NAT'L RESEARCH COUNCIL, RESTORATION OF AQUATIC ECOSYSTEMS (1992). Technically, the National Academy of Sciences, a group of elected members, operates through the National Research Council (NRC). *Id.* at viii. The NRC organizes government and other funded research on a wide range of policy issues with a major scientific or technical component. *Id.*

14. *Id.* at 18. In 1994, the Ecological Society of America adopted a resolution that defines restoration as "the process of repairing damage caused by humans to the diversity and dynamics of indigenous ecosystems." Laura L. Jackson et al., *Ecological Restoration: A Definition and Comments*, 3 RESTORATION ECOLOGY 71, 71 (1995).

15. NAT'L RESEARCH COUNCIL, *supra* note 13, at 17. The effort to reverse the damming of Hetch Hetchy Valley is an example of the correct but problematic use of the term restoration. *See* RICHARD WHITE, IT'S YOUR MISFORTUNE AND NONE OF MY OWN 412-15 (1991). The cause célèbre of the preservation movement in the early twentieth century was the construction of O'Shaughnessy Dam and Hetch Hetchy Reservoir north of Yosemite National Park to supply San Francisco with water. *Id.* The city is now planning to spend over four billion dollars to make the water delivery system more earthquake resistant. Chuck Carroll, *Back to the Past: Environmentalists Want Study on Tearing Down Dam at Hetch Hetchy to Restore Nature*, SAN JOSE MERCURY, Aug. 11, 2002, Posting from Jeffrey Cohen, WATER45@email.msn.com, to http://listhost1.water.ca.gov/mailman/listinfo/water news (Aug. 11, 2002) (on file with *Minnesota Law Review*). Several NGOs have announced that they will oppose the plan unless the city studies the feasibility of removing the dam, restoring the valley to its "original" state, and storing the water in a reservoir closer to San Francisco. Dean E. Murphy, *Conservationists Try to Undo Large Reservoir in Yosemite*, N.Y. TIMES, Oct. 15, 2002, at A1. The "restoration" of ecosystems through dam removal is not simple. *See* THE H. JOHN HEINZ III CTR. FOR SCI., ECON. & THE ENV'T, DAM REMOVAL: SCIENCE AND DECISION MAKING 47-49 (2002).

16. NAT'L RESEARCH COUNCIL, *supra* note 13, at 18-19. Preservation assumes that the functions to be conserved are intact and thus do not need to be re-created through restoration. *Id.*

almost theological, definitional issues that these efforts raise.

C. ECOSYSTEM REVIVAL AND ITS PROBLEMS

The reasons for the shift from nature preservation to ecosystem revival are numerous. At least in developed countries such as the United States, however, the three most important are necessity, the rise of biodiversity as an organizing concept,[17] and the capture of much environmental discourse by science and welfare economics. Ecosystem revival is necessary simply because there is little "pure" nature to preserve. We have degraded so much, especially in the last two centuries,[18] and much of what we have preserved does not substantially advance the objective of biodiversity conservation. Biodiversity conservation has changed our view of "natural" systems because nature has played a nice trick on us: biodiversity hot spots, rich with species, are generally found in warm areas where there is a very high level of human activity.[19] Many of the vast nature preserves that we have created, such as the National Wilderness system, are in remote, cold areas and therefore not, in fact, rich in biodiversity.[20] Thus, to conserve biodiversity, we must both protect remaining unmodified systems and revive others to create an eco-functional landscape.[21]

Ecosystem revival reflects the triumph of a strictly anthropocentric view of nature over the earnest, but largely unsuccessful, efforts to construct an operational non-anthropocentric view.[22] The environmentalist successors to the preservation movement saw a landscape of awe-inspiring

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17. *See* DAVID TACKAS, THE IDEA OF BIODIVERSITY: PHILOSOPHIES IN PARADISE (1996) (recounting the history of the construction of the term "biodiversity").

18. *See* J. R. MCNEILL, SOMETHING NEW UNDER THE SUN, at xxv (2000) (describing how ecosystem degradation is increasing in scale and magnitude).

19. *See* John Charles Kunich, *Preserving the Womb of the Unknown Species with Hotspots Legislation*, 52 HASTINGS L.J. 1149, 1157 (2001).

20. Jonathan S. Adams et al., *Biodiversity: Our Precious Heritage, in* PRECIOUS HERITAGE: THE STATUS OF BIODIVERSITY IN THE UNITED STATES 3, 17 (Bruce A. Stein et al. eds., 2000); *see also* Michael McCloskey, *Changing Views of What the Wilderness System Is All About*, 76 DENV. U. L. REV. 369, 374-75 (1999) (summarizing the debate between the original advocates of wilderness as a spiritual space and the newer conservation biologists).

21. *See* Andrew C. Revkin, *Forget Nature. Even Eden Is Engineered*, N.Y. TIMES, Aug. 20, 2002, at F4.

22. *See* CHRISTOPHER STONE, EARTH AND OTHER ETHICS: THE CASE FOR MORAL PLURALISM 3-14 (1987) (critiquing non-anthropocentric ethics).

natural areas,[23] endowed with rights,[24] which spiritually uplifted and sustained us by virtue of their physical beauty. For better or worse, this discourse has faded into the background.[25] Environmentalism has become a more rational movement, dominated by economics and ecology.[26] While philosophers continue to debate whether non-anthropocentric ethics are possible, economists and ecologists have progressed operationally by framing the question as a wholly anthropocentric one: What do ecosystems do for us?

Environmental economists, as usual, have a firm answer: Ecosystems are commodities that perform services that can be quantified and even traded. We revive ecosystems to increase their output of high-value goods and services.[27] A recent National Research Council report on the Missouri River advocates a partial restoration of pre-dam flow patterns in part because "[i]t is reasonable to believe that improving ecosystem health, resilience, or biodiversity makes ecosystems more valuable, but that value cannot be measured directly without inquiring into the enhanced flow of services from the healthier ecosystem."[28]

One can contest this analysis because revival is equally as problematic as the earlier, simple idea that we should fence off humans from nature.[29] Bringing back degraded areas raises a

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23. National Park historians agree that the National Park System was created to preserve geologic wonders, not large ecosystems, although later additions had more rational ecological boundaries. *See* RICHARD WEST SELLARS, PRESERVING NATURE IN THE NATIONAL PARKS: A HISTORY 2-3 (1997).

24. *See* RODERICK FRAZIER NASH, THE RIGHTS OF NATURE: A HISTORY OF ENVIRONMENTAL ETHICS 32 (1989).

25. *See* Holly Doremus, *The Rhetoric and Reality of Nature Protection: Toward a New Discourse*, 57 WASH. & LEE L. REV. 11, 13 (2000) (lamenting the loss of wonder and aesthetic enjoyment from environmental discourse).

26. Christopher Schroeder has characterized the environmental movement as a struggle for dominance among prophets, priests, and pragmatists. Christopher H. Schroeder, *Prophets, Priests, and Pragmatists*, 87 MINN. L. REV. 1065 (2003).

27. *See* GRETCHEN C. DAILY & KATHERINE ELLISON, THE NEW ECONOMY OF NATURE 1-17 (2002); James Salzman & J.B. Ruhl, *Currencies and the Commodification of Environmental Law*, 53 STAN. L. REV. 607, 609 (2000).

28. NAT'L RESEARCH COUNCIL, THE MISSOURI RIVER ECOSYSTEM: EXPLORING THE PROSPECTS FOR RECOVERY 101 (2002), *available at* http://www.nap.edu/books/0309083141/html (last visited Mar. 9, 2003).

29. *See* Joseph L. Sax, *Environmental Law at the Turn of the Century: A Reportorial Fragment of Contemporary History*, 88 CAL. L. REV. 2375, 2380-82 (2000) (arguing that this expanded view of nature is the future of

range of questions from the meta-ethical to the technical. In my opinion, however, the real issue is not the ethics of revival but the feasibility.[30] Ecosystem revival will be the biggest conscious landscape management experiment ever undertaken because revival tries to reverse the entire history of human domination of the planet. It may be, as William Rodgers has suggested, another one of our great environmentalist delusions that we can successfully pursue two inconsistent objectives, a working ecosystem and one that works.[31] Or, it may represent the maturation of the environmental movement into a long-term positive force rather than the cult of doom that it often seems to be.[32]

The focus on the revival of degraded systems has the merits of rationality and pragmatism. Efforts to chart the law of ecosystem revival can benefit from the substantial (and continuing) scholarly legacy of Professor Dan Farber applying John Dewey's powerful, pragmatic methods of analyzing and remedying real social problems to environmental law and policy.[33] This Article pays homage to Professor Farber by

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environmental law).

30. Some environmentalists argue that nature can only be protected, not revived, because once it has been degraded, it is no longer a sacred space or a naturally evolving system. *Compare* Eric Katz, *The Big Lie: Human Restoration of Nature*, 12 RES. PHIL. & TECH. 231 (1992) (stating that humans cannot restore damaged nature because all restoration is artificial), *reprinted in* ENVIRONMENTAL ETHICS: AN ANTHOLOGY 390 (Andrew Light & Holmes Rolston III eds., 2003), *with* Andrew Light, *Ecological Restoration and the Culture of Nature: A Pragmatic Perspective*, *in* ENVIRONMENTAL ETHICS: AN ANTHOLOGY, *supra*, at 398 (suggesting an ethical obligation to remedy harms we humans have done to nature and that benign but artificial solutions may be good enough). The case against ecosystem revival is so self-defeating and scientifically irrational that it is easily dismissed. *See* Flournoy, *supra* note 12, at 197-201 (summarizing and evaluating the meta-ethical debate); *see also* JOHN MARTIN GILROY, JUSTICE & NATURE: KANTIAN PHILOSOPHY, ENVIRONMENTAL POLICY, & THE LAW 336-84 (2000); ERIC KATZ, NATURE AS SUBJECT: HUMAN OBLIGATION AND NATURAL COMMUNITY 93-109 (1997).

31. William H. Rodgers, Jr., *The Myth of the Win-Win: Misdiagnosis in the Business of Reassembling Nature*, 42 ARIZ. L. REV. 297, 306 (2000).

32. Environmentalism's gloomy message has been much criticized because it prevents the maturation of the movement. *See, e.g.*, BJORN LOMBORG, THE SKEPTICAL ENVIRONMENTALIST: MEASURING THE STATE OF THE REAL WORLD 321 (2001).

33. *E.g.*, DANIEL A. FARBER, ECO-PRAGMATISM (1999). For an extended discussion of Professor Farber's theory of eco-pragmatism, see J.B. Ruhl, *Is the Endangered Species Act Eco-pragmatic?*, 87 MINN. L. REV. 885 (2003). Like most modern students of Dewey, I do not revisit the question of the competing definitions of truth among pragmatists, *see* 6 THE ENCYCLOPEDIA OF PHILOSOPHY 427-35 (1967), but refer to the John Dewey of *Human Nature and*

trying to follow his ability to get to the root of important issues and by always promoting sound incremental solutions grounded in rationality and feasibility rather than ideology and scientifically unsupportable assertion.

This Article explores some of the underlying scientific and legal problems that are raised by the many large and small ecosystem revival efforts in the United States and throughout the world. Ecosystem revival is a radical departure from past environmental paradigms[34] and, however laudatory, is riddled with unarticulated and inconsistent assumptions which must be articulated and minimized. The structure of environmental law and the culture of the agencies that implement it are based on either the preservation of an undisturbed nature devoid of humans (but rich in fish, birds, and charismatic fauna) or pollution control rather than ecosystem management. We look for quick, technological fixes to mitigate the worst adverse environmental impacts of activities rather than the sustained maintenance of functioning ecosystems. In contrast, revival efforts will require unprecedented, expensive, disciplined, science-based, and pragmatic approaches. Ecosystem revival requires legal actors to set measurable objectives and performance criteria and to undertake long, costly, carefully structured, and controlled experiments under conditions of extreme uncertainty rather than to take *a simple action* to remedy a simple problem. For example, stopping a dam on a scenic preserved river generally requires no further action (except to monitor efforts to revive a rejected project), but efforts to revive a changed and degraded riverine ecosystem, either by recommissioning existing dams or removing a dam, are long-term experiments that carry a high risk of failure.[35]

This Article focuses on four problems of revival: (1) the legal implications of developments in ecology which replace the

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Conduct (1922) and *Logic: The Theory of Inquiry* (1938). Nor do I wish to debate the philosophical importance of Dewey for environmentalism. *See, e.g.*, Larry A. Hickman, *Nature as Culture: John Dewey's Pragmatic Naturalism, in* ENVIRONMENTAL PRAGMATISM 50 (Andrew Light & Eric Katz eds., 1996). For a brilliant history of the cultural milieu that produced pragmatism, see LOUIS MENAND, THE METAPHYSICAL CLUB: THE STORY OF IDEAS IN AMERICA 337-75 (2001). *See also* PRAGMATISM: A READER (Louis Menand ed., 1996).

34. One can, however, find precedents in the New Deal's purchase of private lands for reforestation.

35. *See* THE H. JOHN HEINZ III CTR. FOR SCI., ECON. & THE ENV'T, *supra* note 15, at 113-17 (discussing the need to study the possible adverse effects of dam removal on a river's sediment system).

traditional balance-of-nature metaphor with a more complex, often chaotic conception of ecosystem evolution; (2) the problems of choosing a revival objective that can be made operational; (3) the almost complete misfit between resource conservation law, first generation environmental law, and ecosystem revival; and (4) the unstable blend of scientific expertise with local stakeholder participation in revival experiments which is promoted as "feasible."

II. ECOLOGY: MANY QUESTIONS, FEW ANSWERS

Ecosystem revival requires sustained ecosystem management.[36] The idea that we should manage on an ecosystem scale has been around for over a decade because it seemed better to promote biodiversity conservation and environmental quality enhancement rather than focus narrowly on individual species protection and individual bits of the landscape such as small wetlands.[37] We have no idea if it can be done, however, especially on large scales. To pick one of hundreds of examples, the objective of the Everglades "restoration" plan is to restore sheet flows to the Everglades National Park. Many scientists (as well as an American Indian tribe), however, warn that high flows will compromise the ecologically important tree islands in the Central Everglades above the Park[38] and may increase turbidity and the nutrient load in Central Florida Bay.[39]

Modern ecology makes management more complex because it has substituted moving targets for fixed ones. Modern ecology is an example of environmentalism's troubled relationship with science. Much of environmentalism's legitimacy is derived from science, but science has not delivered the results that it once promised. We have tried to convert

36. *See* JOHN COPELAND NAGLE & J.B. RUHL, THE LAW OF BIODIVERSITY AND ECOSYSTEM MANAGEMENT 318-39 (2002) (containing a collection of materials on the meaning of ecosystem management).

37. *See* Daniel Simberloff, *Flagships, Umbrellas, and Keystones: Is Single Species Management Passè in the Landscape Era?*, 83 BIOLOGICAL CONSERVATION 247 (1998).

38. Keith Kloor, *Everglades Restoration Plan Hits Rough Waters*, 288 SCIENCE 1166, 1167 (2000).

39. BD. ON ENVTL. STUDIES & TOXICOLOGY & WATER SCI. & TECH. BD., FLORIDA BAY RESEARCH PROGRAMS AND THEIR RELATION TO THE COMPREHENSIVE EVERGLADES RESTORATION PLAN 9-10, 13-16 (2002), *available at* http://www.nap.edu/books/0309084911/html/index.html (last visited Mar. 9, 2003).

ecology into a regulatory science that can answer socially constructed questions such as the long-term cumulative environmental impacts of small incremental actions. We now know that managing nature to achieve environmental benefits is much more complex than initially imagined. Ecology has made its application even harder by substituting a dynamic for static view of nature and deconstructing all concepts from ecosystem to species.

The first concept to go is the idea that nature is sacred space. Environmentalism's patron saint is John Muir.[40] Saint John of the Mountains played a major role in making nature preservation a national political objective. Although modern environmental historians have attempted to portray Muir as a proto-ecologist,[41] nature preservation was largely undertaken for spiritual, aesthetic, and commercial reasons.[42] For example, the railroads played a major role in promoting the establishment of national parks.[43] Nonetheless, Muir's legacy is that a primary objective of what we now call environmentalism is to fence large areas of nature from human exploitation and to limit human enjoyment to uses compatible with the values of the preserved space.[44] Nature preservation helped to lay the groundwork for the broader objectives of ecosystem stability and biodiversity conservation.

In the twentieth century, the emerging discipline of ecology reinforced the fencing off strategy but added a more explicit scientific rationale to the spiritual and aesthetic impulses. Natural areas were reconceptualized from sacred or wondrous spaces to harmonious, balanced ecosystems.[45] Ecology initially

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40. *See* STEPHEN R. FOX, JOHN MUIR AND HIS LEGACY: THE AMERICAN CONSERVATION MOVEMENT (1981).

41. *See* MICHAEL P. COHEN, THE PATHLESS WAY: JOHN MUIR AND AMERICAN WILDERNESS 330-31 (1984).

42. *See supra* notes 10, 23.

43. *See* ALFRED RUNTE, NATIONAL PARKS: THE AMERICAN EXPERIENCE (2nd ed. 1987).

44. *See* Sax, *supra* note 29, at 2378 ("The first era of environmental legislation implemented a sort of 'enclave' theory of protection.").

45. Russian scientists played a key role in redefining nature as ecosystems whose functioning could be understood through science. The triumph of Marxist science over ecological approaches to nature conservation has destroyed much of this legacy. *See* DOUGLAS R. WEINER, MODELS OF NATURE: ECOLOGY, CONSERVATION, AND THE CULTURAL REVOLUTION IN SOVIET RUSSIA (1988). Frank 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, but that

portrayed ecosystems as progressing through successive stages to climax and a steady state equilibrium. At the dawn of the environmental movement, lawyers derived a powerful and general lesson from ecology: Let nature be. The ur-text was 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."[46] Leopold's land ethic has emerged as the leading land use management alternative to the progressive conservation movement's ethic of efficient multiple use of resources and has provided the basis for powerful resource preservation laws.[47]

Leopold and the leading ecologists of his day, such as Eugene Odum, provided an ecological justification for a land ethic based on the equilibrium paradigm in ecology, or, as it was crudely and popularly expressed: the "balance of nature."[48] Legislators and lawyers enthusiastically embraced this paradigm because it seemed to be a neutral, universal public policy principle applicable to the use and management of all natural resources.[49] The contributions of modern environmental resource management to the legal system—the National Environmental Policy Act, the Endangered Species Act, the Wilderness Act of 1964, the Clean Water and Clean Air Acts, especially the non-degradation provisions and section 404

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ecologists concealed problems of theory and method as they "passively accepted the buzzing activity." FRANK BENJAMIN GOLLEY, A HISTORY OF THE ECOSYSTEM CONCEPT IN ECOLOGY: MORE THAN THE SUM OF THE PARTS 3-4 (1993).

46. ALDO LEOPOLD, A SAND COUNTY ALMANAC AND SKETCHES HERE AND THERE 224-25 (1949). Leopold is also the Socrates of postmodern environmental ethics. *See, e.g.*, J. BAIRD CALLICOTT, IN DEFENSE OF THE LAND ETHIC: ESSAYS IN ENVIRONMENTAL PHILOSOPHY 223-47 (1989); PAUL W. TAYLOR, RESPECT FOR NATURE: A THEORY OF ENVIRONMENTAL ETHICS 285-86 (1988); LAURA WESTRA, AN ENVIRONMENTAL PROPOSAL FOR ETHICS: THE PRINCIPLE OF INTEGRITY (1994). *See generally* CURT MEINE, ALDO LEOPOLD: HIS LIFE AND WORK (1988) (tracing the evolution of Leopold's thinking based on his conservation experience).

47. There are several good case studies of the search for alternative paradigms. *See, e.g.*, DAVID L. FELDMAN, WATER RESOURCES MANAGEMENT: IN SEARCH OF AN ENVIRONMENTAL ETHIC 81-107, 132-56 (1991); RONALD A. FORESTA, AMAZON CONSERVATION IN THE AGE OF DEVELOPMENT: THE LIMITS OF PROVIDENCE 6-31 (1991).

48. EUGENE P. ODUM, FUNDAMENTALS OF ECOLOGY 25-26 (2nd ed. 1959).

49. *See* A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOY. L.A. L. REV. 1121, 1122 (1994).

of the Clean Water Act—are premised on this paradigm.[50]

In the past two decades the scientific foundations of the fencing off strategy have eroded. In the still under-appreciated book, *Discordant Harmonies*, Daniel Botkin "deconstructed" the equilibrium paradigm as a misguided effort to match science to theological and scientific visions of a perfect universe.[51] He argued that the images of nature which have influenced ecology are erroneously static when in fact resource use problems require a more accurate view of nature as dynamic, a view which starts from the premises that human action is one of the principal forces operating on ecosystems and that system disturbances are both predictable and random.[52]

The scientific foundations of Leopold's vision have been eroded by more sophisticated theories of ecosystem behavior.[53] We now study ecosystems at larger scales and have a better understanding of their dynamic nature.[54] We now realize, however, that we know less about the long-term functioning of these systems than we thought we did.[55] We know we must take a much more comprehensive approach to their care, even if we are unsure of the scale of management. The objective is not to preserve their stability to maintain their resilience over time. As a leading ecologist explains, "some of the most telling properties of ecological systems emerge from the interactions between slow-moving and fast-moving processes and between processes that have large spatial reach and processes that are relatively localized. Those interactions are not only nonlinear;

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50. Wilderness Act, 16 U.S.C. §§1131-1136 (2000); Endangered Species Act, 16 U.S.C. §§ 1531-1544; Clean Water Act, 33 U.S.C. §§ 1251-1387 (2000); Clean Air Act, 42 U.S.C. §§ 7401-7671a (2000); National Environmental Policy Act, 42 U.S.C. §§ 4321-4370f.

51. DANIEL B. BOTKIN, DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE TWENTY-FIRST CENTURY 6-12 (1990); *see also* DANIEL BOTKIN, NO MAN'S GARDEN: THOREAU AND A NEW VISION FOR CIVILIZATION AND NATURE 18-19, 80 (2001).

52. *See supra* note 51. Stephen Toulmin has traced the roots of the quest for stability in Western thought from Newton to the present and argues that the pursuit of universal principles remained the norm "up to John Dewey's time." Stephen Toulmin, *The Idol of Stability*, *in* 20 THE TANNER LECTURES ON HUMAN VALUES 325, 353 (1999).

53. J. Baird Callicott, *Do Deconstructive Ecology and Sociobiology Undermine Leopold's Land Ethic?*, 18 ENVTL. ETHICS 353 (1996).

54. *See* Fred Bosselman, *What Lawmakers Can Learn from Large-Scale Ecology*, 17 J. LAND USE & ENVTL. L. 207, 207-21 (2002).

55. *Id.* at 257-58.

they generate alternating stable states."[56] As a result, the original concept of resilience as a near equilibrium steady state has been replaced, and ecologists try to measure resilience "by the magnitude of disturbance that can be absorbed before the system changes its structure by changing the variables and processes that control behavior."[57]

Some ecologists have drawn a startling conclusion from the new ecology: The current concept of an ecosystem may no longer be a meaningful construct. The reason is that the new ecology undermines the crucial assumptions of the concept. Ecology has traditionally assumed that an ecosystem has definable boundaries, that it has spatial homogeneity, that we may substitute different flora and fauna and still maintain a sustainable system, that natural selection is relatively unimportant, that we can identify stability levels at different scales, and that humans are not part of ecosystems.[58] These simplistic assumptions are now being recast as more complex, open-ended criteria that emphasize that stability is a function of the time scale of observation and the balance between "(a) rates of change in environmental condition, and (b) rates of change in the biota."[59] For the foreseeable future, the ecosystem concept will never be totally abandoned. In the future, however, an ecosystem could be redefined as an "ecological system" with a range of spatial scales depending on the time frame adopted, with a wide potential, non-constant dispersal range for each species, and in which species interact to maximize biotic potential. Such systems may maximize local biotic potential at the same time that they begin to exhibit signs of long-range change.

The first lesson of the new ecology and the deconstructed ecosystem for revival is that we can never return to a state of nature; we can only approximate it for an undetermined period of time. The idea that ecosystems are moving rather than fixed targets and must be "mapped" at larger scales will subject the relevant environmental sciences to even greater stress.

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56. C.S. Holling et al., *In Quest of a Theory of Adaptive Change*, *in* PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS 3, 9 (Lance H. Gunderson & C.S. Holling eds., 2002).

57. C.S. Holling & Lance H. Gunderson, *Resilience and Adaptive Cycles*, *in* PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS, *supra* note 56, at 25, 28.

58. Robert V. O'Neill, *Is It Time to Bury the Ecosystem Concept? (With Full Military Honors, of Course!)*, 82 ECOLOGY 3275, 3277-79 (2001).

59. *Id.* at 3281.

Scientists must answer questions that require mixed scientific and policy judgments. In contrast, environmental law and policy still have a tendency to view degraded ecosystems as broken machines. We want to know the causal relationship between the installation of a new part, a management action (experiment), and improved performance, an ecologically beneficial outcome. Science can rarely answer the causal relationship with the expected confidence or comfort level because it requires unprecedented and costly levels of data assembly and synthesis and the need to endlessly revisit previous conclusions and judgments.

The more complex view of ecosystem evolution that ecologists propound is only one of the many problems that advances in biology and ecology pose for ecosystem revival. Along with ecosystems, our understanding of a species has changed. The future role of the Endangered Species Act (ESA) in ecosystem revival is a case in point. Current revival efforts are often driven by the ESA as public and private parties often cooperate to develop a Habitat Conservation Plan (HCP) or the equivalent, which may include both preservation and revival initiatives.[60] HCPs are premised on the assumption that they will in fact sustain a listed species.[61] At the same time that scientists were moving toward a more complex theory of the ecosystem, however, biologists were deconstructing the Linnaean hierarchy, which forms the basis for scientific and legal concepts of a species.[62] This thinking has progressed so far that biologists are considering the abolition of all species ranks![63] One implication is that biodiversity, not species, will become the focus of many ecosystem revival efforts. To conserve biodiversity, it will be necessary to "develop valid measures of the diversity of lineage taking into account their actual properties and phylogenic significance."[64] In this new world, we may have more complex and responsive, but contestable, biodiversity protection and revival objectives.

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60. *See* Bradley C. Karkkainen, *Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward a Bounded Pragmatism*, 87 MINN. L. REV. 943 (2003); Ruhl, *supra* note 33.

61. 16 U.S.C. § 1539(a)(2)(B)(iv) (2000).

62. *See* Brent D. Misler, *Getting Rid of Species?*, *in* SPECIES: NEW INTERDISCIPLINARY ESSAYS 307 (Robert A. Wilson ed., 1999).

63. *Id.*

64. *Id.* at 314.

III. REVIVAL OBJECTIONS: BACKWARDS TO WHAT, WHERE, WHEN, WHOM?

Ecosystem revival requires measurable science-based improvement targets, structured system-wide manipulation experiments, monitoring and evaluation, and the inevitable revision of the original objectives, targets, and methods in light of new information. The new ecology teaches that pure restoration—returning to the system's original condition—will often be an unrealistic and unachievable goal. Therefore, it will be necessary to adopt artificial revival targets that approach but do not totally recreate the preexisting "natural" condition, and this must all be done under uncomfortably high levels of scientific uncertainty. The problems start with the first step, the establishment of baselines.[65]

To put the problem in perspective, we should ask why we look back to a superior past. The preservation of physical and cultural artifacts provides some useful lessons for ecosystem revival because its underlying philosophy sheds light on our veneration of the past and suggests alternative uses of the past other than an effort to recapture its original condition.

A. JUST WHY DO WE VENERATE THE PAST?

Ecosystem revival builds from other efforts such as art restoration and the preservation of historical buildings and antiquities. Viewed in the light of these precedents, ecosystem restoration appears as a cultural manifestation of our veneration of historical authenticity. This uniquely Western construct reflects the dynamic nature of Western society and the radical discontinuities that the West has experienced. Europe and America have undergone many cycles of conquest that resulted in a sharp break with the past.[66] Therefore, paradoxically, physical evidence of the past has become an important cultural resource that is best used by preserving the

65. The appropriate baseline is at the heart of debates about the efforts to surround Yellowstone National Park with a protected and "restored" Greater Yellowstone ecosystem. *See* PAUL SCHULLERY, SEARCHING FOR YELLOWSTONE 217-47 (1997) (describing the historic spectrum of viewpoints regarding the management of Yellowstone Park); Duncan T. Patten, *Defining the Greater Yellowstone Ecosystem*, *in* THE GREATER YELLOWSTONE ECOSYSTEM: REDEFINING AMERICA'S WILDERNESS HERITAGE 19, 19-25 (Robert B. Keiter & Mark S. Boyce eds., 1991) (asserting that Yellowstone's ecosystem has no definite boundaries and should be managed as a whole).

66. *See* ALEXANDER STILLE, THE FUTURE OF THE PAST 41-45 (2002).

past as close to its "original" condition as possible.[67] This attitude can be seen in the efforts to identify historical ecosystem baselines for restoration projects. The idea of a baseline, like a Golden Age or the Garden of the Eden, assumes that the system was in balance or functioned "naturally" before European contact. An ecological baseline also rests on the increasingly discredited notion that aboriginal peoples were perfect stewards of nature.[68] Alas, there is no temporal benchmark for revival.

Not all societies venerate tangible remnants of the past. Non-Western perspectives are useful because ecological restoration will ultimately be a forward rather than backward looking process. We will have to synthesize the past, not return to it, and it is important to understand how different cultures view the past. Chinese culture, for example, historically did not value physical authenticity.[69] China was seen as a continuous civilization and, thus, there was no sharp distinction between past and present.[70] In addition, authenticity in art, buildings, and ecosystems reflects an individualistic rather than collective tradition. Thus, China does not distinguish between original and forged art but views accurate copying as a sign of reverence for a past work.[71] The idea that the past has no value at all can go too far. Personally, I have no desire to see a world of totally artificial or, worse yet, virtual ecosystems,[72] but the Chinese view that the past can

67. *See id.*

68. *See supra* note 8 and accompanying text.

69. STILLE, *supra* note 67, at 40-41.

70. *See id.* at 42.

71. *See id.* at 41-42.

72. When the economist John Krutilla first argued that resources like a remote scenic area had value because people would pay to preserve it for its option value, it triggered a rebuttal. John Krutilla, *Conservation Reconsidered*, 57 AM. ECON. REV. 777 (1967). In a provocatively titled piece, *What's Wrong with Plastic Trees?*, 179 SCIENCE 446, 447, 453 (1973), Martin Krieger argued that just as people can be educated to prefer wilderness, people could be educated to accept low-cost artificial environments in place of high-cost natural areas. Today, we would undoubtedly argue that we can be educated to accept fantasy, virtual ecosystems. In response to the question, "What's wrong with plastic trees?" Krieger answered "very little," because "more can be done with plastic trees . . . to give most people the feeling that they are experiencing nature." *Id.* at 453. All environments could become Disney recreations of nature. This argument is profoundly disturbing to environmentalists. Laurence H. Tribe responded with a tentative theory, rooted in pantheism or, more accurately, panpsychism (a theory that accords all objects in the universe an inner or psychological being), of a social order

guide re-creation rather than restoration of something lost is a useful perspective for ecosystem revival.

B. WHAT, IF ANY, ARE THE LESSONS OF THE HISTORIC PRESERVATION MOVEMENT?

Proponents of historic preservation have struggled to define their objectives since the movement began in the nineteenth century and to develop pragmatic solutions to the re-creation of the past.[73] The analogy between historic preservation and ecosystem revival, though imperfect, provides useful lessons. Structures, in contrast to ecosystems, are static rather than dynamic systems. Any change will endure with proper maintenance. In addition, the objectives of historic preservation, as opposed to its techniques, need not be informed by science. This said, the discussion is useful precedent. When he became head of the French Monument Service in 1843, Prosper Merimee, best known as the author of the short story from which Bizet drew his opera *Carmen*, distinguished between conservation and re-creation.[74] The first attempts were to recapture the past form of an extant building and to construct a replica of something that had ceased to exist.[75] Later, Eugene Emmanual Violet le Duc, the architect of what we know today as the walled city of Carcassonne, uttered his famous definition of restoration as "a completed

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based on equal dignity under the law for all aspects of nature. Laurence H. Tribe, *Ways Not to Think About Plastic Trees: New Foundations for Environmental Law*, 83 YALE L.J. 1315, 1339-40 (1974).

73. This idea originates from the campaign of Violet-le-Duc to rebuild Carcassonne after the restoration of the French Monarchy in 1815, which represented a conservative Romantic nostalgia for a lost if mythic past. JOHN B. WOLF, FRANCE: 1814-1919, THE RISE OF A LIBERAL-DEMOCRATIC SOCIETY 38-41 (1963). Joseph L. Sax, *Heritage Preservation as a Public Duty: The Abbé Grégoire and the Origins of an Idea*, 88 MICH. L. REV. 1142, 1152-65 (1990), traces the development of a coherent theory to the reports prepared by the Abbé Grégoire for the French National Convention at a time when many wanted to obliterate all traces of the past, physical or institutional. For example, in 1793, the Committee on Public Safety decreed that the entire city of Lyons should be destroyed, following medieval precedents, because, "Lyons made war on Liberty." WILLIAM DOYLE, THE OXFORD HISTORY OF THE FRENCH REVOLUTION 254-55 (1989). Grégoire proposed a general theory of preserving historical monuments because they are reminders that a great civilization is a tolerant and educated one. *See* Sax, *supra*, at 1155.

74. WILLIAM J. MURTAGH, KEEPING TIME: THE HISTORY AND THEORY OF PRESERVATION IN AMERICA 16 (1997).

75. *Id.*

state which may never have existed at any particular time."[76] Critics are still debating the merits of le Duc's "restoration" of Carcassonne.[77] It is the most complete view of the form of a medieval city, although it certainly represents an idealized view as opposed to the grim reality of what must have actually existed.

Historic preservation suggests that in many, if not most, cases it will not be feasible to restore an ecosystem. We will create something artificial but something that, we hope, will deliver more services than the degraded ecosystem. Current revival experiments finesse this problem by not setting any permanent system-wide objectives, but usually focus on the survival of an indicator (usually threatened or endangered) species.[78] Process is substituted for substance, and the result is often long delay, increased conflict and partial solutions. For example, a National Research Council Committee, studying the decade-long efforts to mitigate the downstream adverse environmental impacts of Glen Canyon dam on the Colorado River through a flow regime closer to the pre-dam hydrograph,[79] noted that no agency had set any long-term flow objectives related to a vision of the canyon ecosystem and proposed an approach to doing so:

> While many aspects of the Grand Canyon are in fact natural or at least not subject to management or direct human perturbation, the

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76. *Id.*

77. *Id.* at 17-21.

78. For example, the fresh-saline water balance has been deteriorating in the Sacramento-San Jaoquin Delta of California for decades, and a massive process has been launched to try to balance ecosystem protection and the continued diversion of large amounts of water from the system for use in the Central Valley and southern California. A. DAN TARLOCK ET AL., WATER RESOURCE MANAGEMENT: A COURSEBOOK IN LAW AND PUBLIC POLICY 697-702 (2002). These efforts focused on the narrow objective of sustaining an endangered fish, the Delta Smelt. The fish has survived by a thin margin and agricultural water users are now agitating to remove the species from the ESA protected list. Mike Taugher, *Delta Smelt's Health Called into Question*, CONTRA COSTA TIMES (Walnut Creek, CA), Oct. 19, 2002, *available at* 2002 WL 100622157. The Delta ecosystem remains at risk, but the focus on an indicator species rather than more comprehensive revival objectives hinders the ability of regulators and stakeholders to focus on the real issue.

79. As a result of the identification of adverse environmental impacts, the Bureau of Reclamation released a spring beach building flow in 1996, but the experiment did not achieve its objective. Associated Press, *Federal Agency Has New Plan for Flushing Grand Canyon*, LAS VEGAS SUN, *available at* http://www.lasvegassun.com/sunbin/stories/text/2002/sep/24/092410199.html (Sept. 24, 2002). Scientists did learn that releases could move sediment out of the tributaries into the canyon and are now proposing a January flood. *Id.*

> river itself and the riparian corridor inevitably are a reflection of human action because of the existence of Glen Canyon Dam. . . . The GCES [Glen Canyon Environmental Studies] has shown that operation of the dam can be modified in various ways to restore a greater degree of naturalness to the river and riparian environments through maintenance or restoration of physical characteristics of the environment such as beaches or biotic resources such as endangered species. . . . [O]ne obvious basis for future management of Glen Canyon Dam might be characterized as simulated naturalness, which could be defined as the use of operational flexibility to restore and maintain environmental conditions in the national park that resemble as nearly as possible the original condition of the river.
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> Many aspects of the river corridor in Grand Canyon National Park cannot feasibly resemble the original river corridor . . . however, there are many ways in which the environmental conditions along the river can be restored to a more natural state. These possibilities, some of which are in place or under construction, include adaptation of a more natural hydrologic regime, the introduction of controlled floods, restoration of seasonally warm water in the river, and maintenance of habitat and physical features such as beaches through manipulation of water and sediment. The adoption of simulated naturalness would give a unifying theme and purpose to operational changes with these objectives, and would provide a blueprint for the future.[80]

C. AN EXAMPLE OF SIMULATED NATURALNESS

Australia's management of the Murray-Darling Basin, which is plagued with environmental problems from saline land to degraded aquatic ecosystems, is one of the world's most ambitious ecosystem revival experiments. It is an example of an effort by ecologists to establish a "normative" river.[81] Australia's management also illustrates how the revival standard must modify harmful resource use decisions, and thus limit existing entitlements, throughout this system. In 1992, Australia's federal government and the basin states agreed to the Murray-Darling Initiative to conserve the river's ecosystem.[82] The Initiative led to the adoption of the federal-state Murray-Basin Agreement and the creation of a joint

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80. NAT'L RESEARCH COUNCIL, RIVER RESOURCE MANAGEMENT IN THE GRAND CANYON 47-48 (1996), *available at* http://www.nap.edu/books/0309054486/html (last visited Mar. 9, 2003). I wrote this paragraph as a member of the National Research Council Committee to review the Glen Canyon Environmental Studies.

81. Jack A. Stanford et al., *A General Protocol for Restoration of Regulated Rivers*, 12 REG. RIVERS: RES. & MGMT. 391, 404 (1996).

82. MURRAY-DARLING BASIN COMM'N, ANNUAL REPORT 1998-99, at 7 (1999), *available at* http://www.mdbc.gov.au/naturalresources/polices_strategies/projectscreens/the_cap.htm (last visited Mar. 3, 2003).

federal-state commission overseen by a federal-state ministerial council.[83] Unlike an interstate compact within the United States or an international treaty, the Agreement imposes much more detailed land use and water management duties on the parties and is constantly amended. It both allocates the flow among the basin states and vests the Commission with the power to control releases from specified upstream storage facilities.[84] The Murray-Darling Commission now runs the river, with supervision by the ministerial council and a stakeholder advisory board.[85]

The Commission's adoption of an artificial base flow regime and its imposition of that regime on existing users throughout the basin set an important precedent for other legal systems. The Commission has initiated a process to set environmental or base flows for ecosystem restoration based on the impacts of different flows on the riverine environment.[86] On developed river basins, the problem with establishing new flow or hydrograph regimes is vested rights, whether real or merely claimed. Both the federal and state governments recognized the need to limit water withdrawals, to establish base flows, and to stabilize and restore productive agricultural areas, especially those degraded by salinization.[87] In 1996, the Commission announced the "CAP" which is the "cornerstone of a number of policies designed to manage water resources for scarcity: water trading, environmental flows and the security of property rights."[88] The CAP imposes yearly diversion limits on the four basin states and the Australian Capital Territory.[89] New South Wales agriculture accounts for many of the stresses on the basin, and the Commission imposed a state cap based on

83. Murray-Darling Basin Agreement (1992), *available at* http://www.mdbc.gov.au/about/governance/_pdf_word/MDBAgreement.pdf (last visited Jan. 19, 2003).

84. *Id.*, pt. X.

85. *Id.*, pts. III, IV.

86. *Id.*, pts. V, VI.

87. *Id.*

88. MURRAY-DARLING BASIN COMM'N, *supra* note 82, at 24. The ministerial council has commissioned a five year review of the CAP to "identify any impediments and constraints to its full operation." REVIEW OF THE OPERATION OF THE CAP: OVERVIEW REPORT OF THE MURRAY-DARLING BASIN COMMISSION 21 (2000), *available at* http://www.mdbc.gov.au/naturalresources/policies_strategies/projectscreens/pdf/FINAL_Report-Nov_00.pdf (last visited Jan. 19, 2003).

89. MURRAY-DARLING BASIN COMM'N, *supra* note 82.

1993-94 withdrawal levels.[90] The caps will vary year to year according to the supply.[91] They are administered by each state and will require aggressive management as agricultural water diversions are increasing in both New South Wales and Queensland.[92]

Australia is prone to prolonged periods of severe drought that alternate with wet years.[93] Diversions are increasing upstream in Queensland and in many New South Wales inland agricultural districts.[94] In 1996-97 three major sub-basins in New South Wales exceeded the CAP.[95] Adherence to the CAP will require many innovative management strategies such as conjunctive use of ground and surface water, an abandonment of the "use it or lose it" administration of water licenses, and the implementation of an accounting system to balance water use over time.[96] Still, the Commission predicted that the CAP would be met in all states except New South Wales.[97] Only one basin, the Lahlan, clearly exceeded the CAP in 1997-98, its first years of implementation, but usage in other major basins is approaching the CAP and may exceed it, especially if development is allowed to increase.[98] The ability of the CAP to restore the Murray-Darling will not be known for years. The initial experience, however, suggests that plans which try initially to maintain the status quo and then to promote gradual and modest rollbacks in existing uses can be fair,

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90. MURRAY-DARLING BASIN COMM'N, MURRAY-DARLING BASIN CAP ON DIVERSIONS: WATER YEAR 1997/98 STRIKING THE BALANCE (1998), *available at* http://www.mdbc.gov.au/naturalresources/policies_strategies/projectscreens/pdf/Striking_the_Balance_Report_97_98.pdf (last visited Jan. 19, 2003).

91. *Id.*

92. *See* MURRAY-DARLING BASIN COMM'N, WATER AUDIT MONITORING REPORT 1996/97, REPORT OF THE MURRAY-DARLING COMMISSION ON THE FINAL YEAR OF THE INTERIM CAP IN THE MURRAY-DARLING BASIN 11-13, 17-19 (1998), *available at* http://www.mdbc.gov.au/naturalresources/policies_strategies/projectscreens/pdf/Water_Audit_Monitoring_Report_97_98.pdf (last visited Jan. 19, 2003).

93. *See generally id.*

94. *Id.* at 11-13, 17-19.

95. *Id.* at 10.

96. MURRAY DARLING BASIN COMM'N, *supra* note 90, at 10.

97. *Id.*

98. Water diversions in the Murrumbidgee Valley are approaching the upper confidence levels of the CAP, and irrigation is projected to increase. MURRAY-DARLING BASIN COMM'N, REVIEW OF CAP IMPLEMENTATION 1997/98 REPORT OF THE INDEPENDENT AUDIT GROUP (1998), *available at* http://www.mdbc.gov.au/naturalresources/policies_strategies/projectscreens/pdf/IAG_Report_97_98.pdf (last visited Jan. 19, 2003).

efficient, and environmentally beneficial. In major river systems there is almost always wasteful agricultural water use and use in excess of legal entitlements. The CAP thus gives river managers some flexibility to experiment without the undue dislocation of legitimate user expectations.

The ultimate test of revival is whether it drives subsequent resource choices, including the reduction of existing entitlements. There are various ways to reduce existing claimed entitlements, and the CAP illustrates a flexible device for doing this. One example of this is the Pilot Interstate Trading Program (Pilot) in the Mallee Region of South Australia, Victoria, and New South Wales along the lower Murray. Water prices and agricultural crops are similar in the three states.[99] Under the Pilot, individual diverters with high security water rights may sell water across state lines, provided that the water licensing authorities in each state agree to the transfer.[100] One of the major unresolved issues in water marketing is the integration of markets with environmental protection. The Pilot does this by establishing exchange values (the amount of water that may be transferred) among states.[101] Trades by upstream diverters from New South Wales to Victoria, and from Victoria to South Australia, have a 1.0 exchange rate, which means that 100% of the entitlement can be transferred.[102] On the other hand, transfers from South Australia, which is downstream, to the upstream states of Victoria and New South Wales have an exchange rate of 0.9 so that only 90% of the entitlement can be transferred to prevent further salt concentrations in the river.[103]

IV. THE INSTITUTIONAL BARRIERS

Revival efforts raise legal and institutional problems because neither the concept of biodiversity conservation nor of

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99. MURRAY-DARLING BASIN COMM'N, THE PILOT INTERSTATE WATER TRADING PROJECT, *available at* http://www.mdbc.gov.au/naturalresources/policies_strategies/projectscreens/pilot.watertrade.htm (last modified June 18, 2002).

100. *Id.*

101. *Id.*

102. *Id.*

103. *Id.* For a recent study of the basin which documents the emergence of water trading to reallocate water, see DARLA HATTON MACDONALD AND MIKE YOUNG, A CASE STUDY OF THE MURRAY-DARLING BASIN: FINAL REPORT FOR INTERNATIONAL WATER MANAGEMENT, *available at* www.clw.csiro.au/publications/consultancy/2001/MDB-IWMI.pdf (last visited March 8, 2003).

ecosystem revival is well integrated into our natural resource use and environmental laws. Moreover, the institutional cultures of the resource management and environmental protection agencies do not support long-term, risky management. There are two legal paradigms for the ecosystem. The dominant paradigm, which is still very much alive, is that ecosystems are commodity treasure chests to be exploited for human use.[104] Our resource use laws still reflect this nineteenth century premise.[105] Laws are designed to set minimum standards for the conversion of public resources into private entitlements within minimal restrictions on exploitation.

In the twentieth century we modified this paradigm by adding three central ideas to commodity production. First, in the early twentieth century we decided that some natural areas should not be developed and instead should be set aside for parks or wilderness areas.[106] The progressive conservation movement contributed the twin ideas that some lands should be withdrawn from development and that mindless exploitation should be regulated by the government to promote more efficient resource use.[107] We still work with the public lands management categories left by these legacies: National Forests, Wilderness Areas, National Parks, and Bureau of Land Management Lands. Second, in the 1960s the environmental movement contributed the powerful but limited ideas that environmental impacts should be assessed before undertaking an activity, less environmentally destructive alternatives should be considered,[108] and agencies should engage in more comprehensive planning.[109] Third, environmental impact

104. *See supra* note 72.

105. *See supra* note 50.

106. *See* RUNTE, *supra* note 43.

107. *See* SAMUEL P. HAYS, CONSERVATION AND THE GOSPEL OF EFFICIENCY: THE PROGRESSIVE CONSERVATION MOVEMENT 1890-1920 (1959).

108. Impact assessment is mandated by the National Environmental Policy Act of 1969, 42 U.S.C. § 4332(2)(c) (2000). NEPA has been construed by the Supreme Court to impose procedural, but not substantive, duties on agencies. Marsh v. Oregon Natural Res. Council, 490 U.S. 360, 375-78 (1989). This decision has led to an extensive debate on the effectiveness of information assembly and disclosure as an instrument of environmental protection. *See, e.g.*, Bradley C. Karkkainen, *Toward a Smarter NEPA: Monitoring and Managing Government's Environmental Perfomance*, 102 COLUM. L. REV. 903, 906-32 (2002).

109. *See* GEORGE C. COGGINS & ROBERT L. GLICKSMAN, PUBLIC NATURAL RESOURCES LAW at chs. 6-7 (1991).

assessment led to the idea that the most serious adverse environmental impacts should be mitigated to the extent that mitigation is technically and economically feasible.[110]

These ideas advanced environmental protection from a marginal to an equal resource policy objective. The continuing legacy of the nineteenth century tradition of public land disposition is, however, that rational mitigated exploitation is the primary management objective rather than biodiversity conservation and ecosystem improvement. For example, federal land managers still retain great discretion to strike the final balance among the full range of possible uses, including revival.[111] Generally, new environmental objectives have simply been superimposed over existing exploitation objectives. The controls on discretion remain primarily political rather than judicial. As a result, it is virtually impossible to convince a court to reverse a management decision which trades biodiversity conservation or revival for some other permissible objective after due consideration. Likewise, it is very difficult to contest a decision that opts for limited mitigation over comprehensive ecosystem revival.[112] Judicial review is possible, but courts are likely to intervene only when federal land management agencies have delegated authority to local resource users in a way that creates a substantial risk that federal management duties, including biodiversity conservation, will be compromised,[113] or when there is a clear

110. The contrast between this objective and the broader objective of maintaining functioning ecosystems through management and revival is captured in the observation of an environmental regulator commenting on a Rutgers University study of the effects of urban sprawl on New Jersey's climate. "It's one thing for the state to say you have to control this amount of polluted runoff. . . . It's another to say you have to maintain this forest cover or this result will occur far away. That's not the traditional bailiwick of environmental regulation. We'll have to evolve ourselves to get to that point." Kirk Johnson, *Mostly Sprawling and Warmer: Scientists Look at How Land Use Affects New Jersey's Climate*, N.Y. TIMES, Oct. 24, 2002, at A28.

111. The formal basis for deference to public land management decisions are the Supreme Court opinions in *United States v. Mead Corp.*, 533 U.S. 218 (2001), *Christensen v. Harris County*, 529 U.S. 576 (2000), *Chevron U.S.A. Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837 (1984), and *Udall v. Tallman*, 380 U.S. 1 (1965). The Court's *Chevron* doctrine permits a court to refuse to defer to some agency interpretations its authority but deference remains the norm.

112. *See, e.g.*, Sierra Club v. Marita, 46 F.3d 606 (7th Cir. 1995).

113. *E.g.*, Nat'l Park & Conservation Ass'n v. Stanton, 54 F. Supp 2d. 7, 15-16 (D.D.C. 1999); Natural Res. Def. Council, Inc. v. Hodel, 618 F. Supp. 848 (E.D. Cal. 1985).

failure to implement a statutory mandate.[114]

The net result is that environmental law is long on process and short on substance. This structural flaw makes ecosystem revival especially difficult because the ability to revive requires both the legal authority for substantive long-term management objectives and an agency culture of long-term experimentation. Under existing statutes and agency cultures, it has proved very difficult to get agencies to focus on the long term because of the high degree of uncertainty about the future. For example, courts are becoming more aggressive in policing impact statements that have truncated discussions of cumulative impacts,[115] but a fundamental reorientation of NEPA is required to expand the time horizon of agencies.[116]

The growing use of Adaptive Management (AM) illustrates the institutional problems inherent in revival. AM arose in the 1970s as a remedy to the problem that "fixed review of an independently designed policy" was inconsistent with the experience of resource managers worldwide who made decisions under constantly changing conditions.[117] The need for rigorous but flexible procedures to make decisions under conditions of extreme uncertainty has a long intellectual pedigree. Howard Raiffa's pioneering work in the 1960s on decision analysis, which led to his famous decision trees,[118] was one of the major influences on the development of AM.[119] AM compliments the precautionary principle, which is a tool to overcome uncertainty, because it corrects both biases toward inaction in the face of uncertainty and immediate fixes unconnected to long term monitoring and assessment.

AM is almost always used in revival efforts, and the problems with its use start with the establishment of objectives. Any effort to recreate past conditions requires

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114. Oregon Natural Desert Ass'n v. Singleton, 47 F.Supp 2d. 1182 (D. Or. 1998).

115. *E.g.*, Texas Comm. on Natural Res. v. Army Dep't, 197 F. Supp 2d. 586 (N.D. Tx. 2002). *See* Laura Hartt, Pacific Coast Federation of Fishermen's Ass'n v. NMFS*: A Case Study on Successes and Failures in Challenging Logging Activities with Adverse Cumulative Impacts on Fish and Wildlife*, 32 ENVTL. L. 671, 671 (2002).

116. *See* Karkkainen, *supra* note 108, at 970-72.

117. ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT 1 (C.S. Holling ed. 1978).

118. HOWARD RAIFFA, DECISION ANALYSIS 10 (1968).

119. ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT, *supra* note 117, at 119.

baselines and performance targets. These are not strictly scientific questions because they require normative judgments about the value of the past and the extent to which we wish to try to re-create it. The information necessary to establish the past may not exist or may present a misleading picture. Nonetheless, these decisions must be informed by science. The correction process over the long term, rather than the quality of data at any given point in the process, is the best guarantee of the integrity of AM. It is a continuous process of acquiring and evaluating new scientific information and adapting it to the experiment.

AM's complexity and rigor make it both politically and legally controversial and a fundamental challenge to the culture of agencies. AM is controversial because it often increases the risk that existing stakeholders might lose their historic entitlements to land development, access to the consumptive or non-consumptive use of water, or commodity production. AM's potential elimination of historic entitlements often raises substantial takings issues under the Fifth and Fourteenth Amendments to the federal Constitution.[120] While AM cannot eliminate all risk, the hope is that scientific information may be able to contain the risk and convince stakeholders that increased risks can be managed. For example, aquatic restoration does not always require water to be available in the same quantities each year.[121] If the resilience of the system were better understood, then stakeholders might be more willing to participate in restoration schemes because the risk of cutbacks in a single dry year might be minimal.

AM's primary cultural challenge is that agencies must live with management choices and uncertain outcomes over a long period rather than going from quick fix to quick fix. This problem is complicated by the fact that AM has been adopted as a quick fix rather than as a fundamental new resource stewardship option to shift the focus from the mitigation of

120. *See, e.g.*, Tulare Lake Basin Water Storage Dist. v. United States, 49 Fed. Cl. 313 (2001).

121. This is the case with the Colorado delta in Mexico, an ecosystem which has been severely compromised by upstream diversions in both Mexico and the United States. A relatively small amount of water appears to be necessary to sustain the ecosystem's critical functions. For a comprehensive survey of restoration options, see Robert Jerome Glennon & Peter W. Culp, *The Last Green Lagoon: How and Why the Bush Administration Should Save the Colorado River Delta*, 28 ECOLOGY L.Q. 903 (2002).

adverse environmental impacts to sustained ecosystem revival.[122] Until the ESA emerged as a major barrier to a wide variety of private and public activities in the late 1980s and early 1990s, there was comparatively little interest in AM both within and without government.

This changed when the Babbitt Department of Interior promoted AM to induce stakeholder participation in large-scale, multi-species HCPs, as a way to counter efforts to roll back the ESA.[123] The process held out the hope to the regulated community that subsequent data might show the need for less rigorous protection standards, and that unforeseen problems could be solved by future but unspecified low-cost corrective actions. Like all tactical policy decisions, however, the adoption of AM as a strategy to save the ESA came with a cost. AM has come to stand for any action that had an experimental component and some monitoring. In fact, AM is not muddling through or applied common sense, as many critics charge.[124] It is a rigorous scientific process which has not yet been accepted as the foundation of all ecosystem revival. The initial use of AM squandered much of its initial theoretical rigor and coherence and made it vulnerable to successful legal challenges.

Challenges to AM are often embedded in challenges to HCP or similar conservation plans which use AM in part to defer important regulatory choices that threaten to undermine the effectiveness of the plan. Courts have held that such plans are inconsistent with the mandates of the ESA, and have, in the process, distinguished between bona fide and faux AM. The most successful challenge to an ineffective plan is *Oregon Natural Resources Council v. Daley*,[125] but the lesson of the case is unclear. In brief, the populations of evolutionary

122. Marc J. Ebbin, *Is the Southern California Approach to Conservation Succeeding?*, 24 ECOLOGY L.Q. 695 (1997).

123. For an insider's perspective, see Joseph L. Sax, *Using Property Rights to Attack Environmental Protection*, 19 PACE ENVTL. L. REV. 715 (2002).

124. *See* John H. Davidson & Thomas Earl Geu, *The Missouri Rive and Adaptive Management*, 80 NEB. L. REV. 816, 849 (2001). These observations are based on the author's service on various National Research Council/National Academy of Sciences committees which recommended the adoption of adaptive management experiments. For a recent statement of the need to realize that adaptive management is a science-driven process that seeks to involve relevant stakeholders in a long term management regime see NATIONAL RESEARCH COUNCIL, THE MISSOURI RIVER ECOSYSTEM: EXPLORING THE PROSPECTS FOR RECOVERY 107-10 (2002).

125. Or. Natural Res. Council v. Daley, 6 F. Supp 2d. 1139 (D. Or. 1998).

significant units of coastal coho salmon have been declining for a variety of anthropocentric and natural causes.[126] The anthropocentric causes include timber harvest practices, livestock grazing, and water diversions.[127] The decision whether to list the coho as a threatened species under the ESA was a political football throughout the 1990s because protection and restoration require intensive management of public and private land and water.[128] There is no quick technological fix, and the reserve strategy applied to terrestrial fauna is not applicable. In 1997, the National Marine Fisheries Service (NMFS) withdrew an earlier proposal to list the coho and decided not to list the coho as threatened because the Oregon Coastal Salmon Restoration Initiative, which supplemented the Northwest Forest Management Plan adopted in 1994 to save the spotted owl, would reverse the population decline.[129] California units were, however, listed because the state apparently made a calculated political decision not to formulate a similar initiative.[130] Scientific opinion within NMFS was divided on the effectiveness of the initiative and on the need to list the species.[131]

A magistrate judge invalidated the decision not to list the species because NMFS applied the wrong ESA standard.[132] A species must be listed if it is likely to become extinct in the foreseeable future, but the NMFS evaluated only the effect of the Initiative on population declines over two years.[133] The primary flaw in NMFS's approach was to base its decision not on science but on faith in future actions taken by the legislative and executive branches of Oregon. "NMFS . . . was unwilling to make the hard choice required by the ESA."[134] Oregon's initiative relied in part on watershed councils where landowner participation was "largely voluntary," and NMFS had rejected California's action plan, in part, because the state had not funded a paper watershed initiative and landowner

126. *Id.* at 1145-46.
127. *Id.* at 1146.
128. *Id.* at 1146-49.
129. *Id.* at 1149-50.
130. *Id.* at 1150, 1159.
131. *Id.* at 1148.
132. *Id.* at 1150.
133. *Id.* at 1151.
134. *Id.* at 1152.

participation was voluntary.[135] The court concluded that reliance on the state's initiative was arbitrary and capricious because it relied on unimplemented, largely voluntary future actions.[136] The court found "telling" the agency's failure to explain why Oregon's initiative did not pose the same risks as California's.[137] "However laudable Oregon's efforts to employ new management techniques to try to restore the Oregon Coast ESU, such future voluntary conservation effort cannot be a substitute for listing."[138]

The difference between AM and a flawed conservation plan relying on it is illustrated by *National Wildlife Federation v. Babbitt*.[139] This case involved an ambitious regional HCP for a 53,000 acre, relatively undeveloped flood plain near Sacramento.[140] Development of this area obligated a multi-jurisdictional agency, the Natomas Basin Conservancy, to assemble several connected blocks of land funded by development fees.[141] In exchange for the plan, the Fish and Wildlife Service (FWS) issued a biological opinion that granted umbrella incidental take permits to several local governments and water districts.[142] HCPs immunize development against a section 9 taking suit in the short term in exchange for the implementation of a multi-species plan over a long period.[143] To do this, the plan had to make crucial assumptions. The Natomas Basin Plan (Plan) assumed that only about a third of the basin would in fact be developed and that future threats to the species's continued survival as development took place around the reserve system could be minimized through aggressive AM.[144]

The National Wildlife Federation challenged the theory that the incidental take permits could precede a complete plan based on extensive scientific research and thus challenged the Plan's reliance on AM to correct any errors in the initial

135. *Id.* at 1156-59.
136. *Id.* at 1159.
137. *Id.*
138. *Id.*
139. 128 F. Supp 2d. 1274 (E.D. Cal. 2000).
140. *Id.* at 1276-77.
141. *Id.* at 1280.
142. *Id.*
143. 16 U.S.C. § 1539(a) (2000).
144. *Nat'l Wildlife Fed'n*, 128 F. Supp 2d. at 1281-82.

scientific assumptions.[145] Specifically, it argued that the Plan must estimate the number of species and the number of permits that would be issued.[146] The court brushed this aside by holding that the HCP met the minimum statutory requirements under *Chevron*.[147] Plaintiffs also challenged the FWS's projection that only 17,500 acres of the basin would be developed and the consequent conclusion that a combination of reserve agricultural land would be sufficient to protect the covered species.[148] These were found to be within the FWS's expert discretion because they concerned "the uncertainties inherent in the market-based mitigation mechanism employed by an HCP" and an inevitable part of the complicated decision making that led to the HCP.[149]

Instead of invalidating the key risk assumptions behind the Plan and AM, the court focused on the weakest deals that placed limits on the future use of AM.[150] These included the lack of regional responsibility and the Department of Interior's (DOI) inability to secure adequate funding.[151] First, the court invalidated as arbitrary the FWS's conclusion that the amount of the mitigation fee would be sufficient to acquire the necessary habitat because it was unsupported by substantial evidence.[152] Administrative purists may object to combining an adjudicative and rule-making standard but the court, in effect, enforced the Supreme Court's *Nollan-Dolan* standard. The *Nollan-Dolan* standard requires that land exactions be based on a reasonable showing of need and that the exaction be proportionate to the need generated by the land use.[153] By failing to demonstrate compliance with the standard, the DOI may have miscalculated the necessary level of exaction. Likewise, the court held that the DOI could not issue a permit after the city refused to assume financial liability for the plan.[154]

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145. *Id.* at 1290.

146. *Id.* at 1291.

147. *Id.*

148. *Id.* at 1296.

149. *Id.* at 1298.

150. *See* John Kostyack, NWF v. Babbitt*: Victory for Smart Growth and Imperiled Wildlife*, 31 ENVTL. L. REP. 10712 (2001).

151. *Nat'l Wildlife Fed'n*, 128 F. Supp 2d. at 1299.

152. *Id.* at 1299-1300.

153. *See* Dolan v. City of Tigard, 512 U.S. 374, 386-96 (1994); Nollan v. California Coastal Comm'n, 483 U.S. 825 (1987).

154. *Nat'l Wildlife Fed'n*, 128 F. Supp 2d. at 1298-99.

The FWS's willingness to proceed without an adequate funding mechanism also extended to its willingness to approve a regional HCP premised on the participation of only one public actor, the city of Sacramento, when, in fact, success ultimately depended on multi-jurisdictional cooperation. This was fatal for several reasons, including the failure to discuss the effect on the reserve and corridor design if only the city participated in the Plan. "In short, the Service's failure to consider whether the survival of the species will be put at risk by the City's permit, if the regional mitigation approach of the HCP is not available, is arbitrary and capricious."[155]

V. STAKEHOLDER PARTICIPATION

Changed public values that lead to alternative landscape visions, hopefully supported by science, will ultimately determine the decision to revive a specific ecosystem. The current thinking is that in the absence of effective federal and state leadership, local or regional collaborative public-private stakeholder processes will be necessary, or at least the best available alternative, to broker many of the revival "deals."[156] Stakeholder-driven processes, so the argument goes, can navigate through the otherwise impassable maze of conflicting entitlement claims and divergent interests.[157] The hope, and it is just that, is that consensus will replace conflict, excessive legal rigidity, litigation, and gridlock with widely acceptable solutions.[158] The rationale for stakeholder or expanded public participation, however, exposes a fundamental tension in ecosystem revival between expertise and lay participation. The question is whether extensive lay participation will be consistent with revival experiments which are fundamentally

155. *Id.* at 1299-30.

156. For a cautiously optimistic assessment of these efforts, see Robert L. Fischman & Jaelith Hall-Rivera, *A Lesson for Conservation from Pollution Control Law: Cooperative Federalism for Recovery Under the Endangered Species Act*, 27 COLUM. J. ENVTL. L. 45 (2002).

157. For a good case study that supports this thesis see Ruth Langridge, *Changing Legal Regimes and the Allocation of Water Between Two California Rivers*, 42 NAT. RESOURCES J. 283, 327 (2002) (arguing that agency and stakeholder participation in decision-making processes promotes river restoration).

158. For a penetrating examination of the weakness of the current mania for consensus processes, see DOUGLAS S. KENNY, ARGUING ABOUT CONSENSUS: EXAMINING THE CASE AGAINST WESTERN WATERSHED INITIATIVES AND OTHER COLLABORATIVE GROUPS ACTIVE IN NATURAL RESOURCES MANAGEMENT (2000).

informed by science.

The root of the tension is the modern disenchantment with the New Deal administrative state. The current focus on stakeholder governance is the latest stage of efforts to use public participation as a counterweight to the narrow focus of expert decision making and the landscape degradation that the mature state produced.[159] Disenchantment began in the 1960s with efforts to halt sterile urban renewal projects that unfairly dislocated poor and minority residents. Public participation raised the voices of marginalized interests and gained strength from powerful theoretical critiques of the administrative state and the idea that sustained it, the public interest.[160] The prestige of science, supported by its role in World War II and the Cold War, diminished. In attacking the *consequences* of the administrative state, environmental NGOs in effect used postmodern thought to discredit science's claimed monopoly on truth by asserting that science and technology, the foundations of the post-New Deal state, are the social products of the current politics.[161] Postmodern thinking, following William James, views all forms of "discourse" as social or political constructs and does not rank the different forms.[162] Thus, ethical postulates or emotional "connections" to a subject are as legitimate as more rational, scientific bases for decision making. This argument is generally coupled with empirical criticisms of the use of science to cabin unacceptably high levels of public health and ecosystem impairment.[163]

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159. *See* THOMAS C. BEIERLE & JERRY CAYFORD, DEMOCRACY IN PRACTICE: PUBLIC PARTICIPATION IN ENVIRONMENTAL DECISIONS 5 (2002).

160. *See* Richard B. Stewart, *The Reformation of American Administrative Law*, 88 HARV. L. REV. 1667 (1975).

161. A. Dan Tarlock, *Who Owns Science?*, 10 PA. ST. ENVTL. L. REV. 135 , 150 (2002).

162. *See* Bird, *supra* note 7.

163. For example, a recent study of the impact of nuclear technology on the Western landscape from nuclear weapons testing to the proposed high-level waste repository in Yucca Mountain links the systems of ecology of Eugene Odum (the proponent of the influential ecological theory that natural systems tended to homeostasis if left undisturbed) and others to the destructive hubris of science:

> Like the models used to determine water pathways to Yucca Mountain today, the models used by Odum and others in ecosystems ecology promised control. The managerial ethos conceptually transforms nature into an integrated circuit, hardwired for work and productivity, a cybernetic system—a predictable, self-regulating system . . . . It is an ethos of control.

VALERIE L. KULETZ, THE TAINTED DESERT: ENVIRONMENTAL AND SOCIAL

Criticism of science does not always appear in this form but is never far from the surface. Stakeholder involvement or lay control generally takes the indirect form of insistence on greater transparency in administrative decision making and increased and more meaningful public participation in the process of the decision. These are laudable, democratic objectives, but transparency and public participation are often used to make two inconsistent claims that can complicate revival actions. At times, they are invoked to allow NGOs and others to "unmask" the scientific assumptions behind a policy and advocate a result not fully supported by conventional science. This argument can take several forms. Some use it to argue for a shift from science to ethics as a basis for legitimate decisions,[164] while others, such as Cass Sunstein, use it to promote greater agency accountability in the use of science to make mixed scientific-ethical decisions.[165]

Others offer a different justification for transparency that finesses these problems and asserts that if the lay public is better informed about the scientific nature of the problem, interested parties will understand the science inherent in a decision.[166] The hope here is that the legitimacy of a science-based decision will be better accepted and will serve to bridge divergent interests. Specifically, this understanding will foreclose inconsistent entitlement claims and other objections to the experiment. For example, this is certainly the case in the argument that public and "stakeholder" involvement is necessary for the successful practice of AM to restore degraded

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RUIN IN THE AMERICAN WEST 278-79 (1998).

164. *E.g.*, Donald T. Hornstein, *Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis*, 92 COLUM. L. REV. 562, 565 (1992).

165. Professor Sunstein has expanded the participatory model of administrative regulation to encourage agencies to be more candid about the uncertainties inherent in modern science-based regulation and to provide better justification and disclosure of the winners and losers of the regulation. Because conventional science is not structured to answer the questions before the agency, he argues that the EPA needs to do a better job of explaining the extent of the adverse effects that it has identified and the reasons that the regulation is suited to the information the agency has developed. This can be done by the preparation of a benefits analysis, which describes in quantitative and qualitative terms the savings from the regulation and outlines at least two alternative regulatory scenarios. The ultimate result could be a common law of health protection based on the candid disclosure of the inferences and assumptions behind a science-based decision. Cass R. Sunstein, *Is the Clean Air Act Unconstitutional?*, 98 MICH. L. REV. 303, 379-80 (1999).

166. *See* Davidson & Geu, *supra* note 124, at 888-89.

ecosystems.

At some point, the tension must be resolved because it is unlikely to be completely eliminated. The tension can complicate revival experiments in several ways. For example, revival is used as a pretext for further degradation, and resort to scientific "evidence" will be necessary to check the faux revival.[167] In other cases, revival objectives may exceed the limits of scientific justification. Sometimes, science may reveal that the geographic scope of the revival experiment is too small. The costly efforts to achieve higher salmon runs in the Columbia River may illustrate both of these points.[168] The best solution is to couple a presumption favoring science-based decision making with public accountability as a checking mechanism. A decision should be classified as science-based if there is a credible, but not necessarily a peer-reviewed, consensus within the scientific community. This analysis rejects the false dichotomy between good and bad or junk science as well as the narrow definition of science adopted by the Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[169] because it is unproductive and non-scientific and increasingly inhibits the use of science in regulatory decision making. Decision makers must be allowed to propose decisions that represent prudent extensions of existing knowledge.

The requirement of a credible scientific foundation rather than a higher but unattainable standard is sufficient to promote the accountability necessary to integrate science into democratic decision making. The burden of disputing a revival strategy should fall on those who disagree with the science. It is legitimate to proceed in the face of uncertainty if there must

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167. The United States Forest Service has the power to launch stewardship contracting projects which can include resource extraction! Many projects that simply exchange timber harvesting for some ecosystem improvements such as increased protection of stream corridors have been criticized, inter alia, as disguised timber sales with no scientific basis. AMERICAN LANDS, STEWARDSHIP CONTRACTING PILOT PROJECTS UNDERMINE ECOLOGICAL RESTORATION, *available at* http://americanlands.org/forestweb/pilot_projects.htm (last visited Jan. 19, 2003).

168. The hard reality of efforts to save various Columbia-Snake River salmon runs is that we have spent several billion dollars in what may be a futile effort. A group advocating the removal of four Lower Snake River dams estimates that more than 3.5 billion dollars has been spent to save runs that may become extinct by 2016. Green Scissors, *Too Dam Much Snake*, *at* http://www.greenscissors.org/water/snakeriver/htm (last visited Mar. 3, 2003).

169. 509 U.S. 579 (1993) (explaining that the primary test of admissibility is peer reviewed literature).

be a reasonable threshold of scientific evidence before it can be invoked and a continuous feedback mechanism that enables the original decision to be reviewed and adjusted in light of new knowledge. Therefore, contesting a decision requires a reasoned, alternative analysis grounded in science. For the regulatory community, the burden will not be different from the one that most courts now apply. A decision can be impeached only by showing the lack of a credible scientific foundation. Scientists must be prepared to answer the questions that legislatures and the public want answered.

CONCLUSION

Ecosystem revival poses a profound challenge to our existing regulatory regime and the culture of the institutions charged with implementing it. So far we have avoided the problem of structural change by making revival an open entry industry. Private entities and all levels of government can undertake revival experiments. There is little coordination among the different legal experiments, in part, because the authority for public revival is either implied or project-specific. In addition, revival is often carried out by resource agencies that are frantically searching for new missions and funding as contemporary politics moves farther beyond their origins in the pre-environmental era. Goals, performance criteria, and feedback or adaptive mechanisms are often nonexistent. We have been living off the intellectual capital of the environmental movement for over three decades, although understandings of the objectives and complexities of environmental protection have rapidly evolved.

Eventually, the nation's environmental laws will have to be revised to reflect the experience of the past thirty years. We need new statutory foundations for ecosystem revival. Agency mandates must be updated to allow more extensive revival assessments. Revival must be defined as a rigorous experiment that sets ecosystem performance targets with the capacity to monitor and assess progress and to modify the experiment. Because revival will never be an exclusively federal (or state) responsibility, agency efforts must be better integrated with stakeholder participation. The process that led to the current Florida Everglades restoration is a possible model. The key state and federal agencies and the NGOs reached an agreement on a restoration plan and got the federal government and the

state of Florida to fund it.[170] Federal and state legislation could offer grants to regional public-private coalitions that want to develop an effective revival strategy that complies with federal environmental and other mandates in a way that would permit a lower but economically rational level of commodity production. Once a plan is approved, a funding package that would address needs such as "victim" compensation would be available to establish performance targets and implement them through an adaptive process.

170. *See* Mary Doyle & Donald E. Jodrey, *Everglades Restoration: Forging New Law in Allocating Water for the Environment*, 8 ENVTL. LAW. 255 (2002).