WHAT LAWMAKERS CAN LEARN FROM LARGE-SCALE ECOLOGY

FRED BOSSELMAN*

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I. INTRODUCTION: SCALE IN ECOLOGY

In the science of ecology, "scale" refers to both space and time. Today, ecological scientists have dramatically expanded their ability to study the natural world in large quantities, both spatially and temporally.[1] The results of this research should lead us to

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* Professor of Law, Chicago-Kent College of Law. A shorter version of this article was presented as a lecture at The Florida State University College of Law, and the article has benefitted from the comments received from those in attendance and from my esteemed colleague, Dan Tarlock. The research has been supported by a grant from the Marshall Ewell Research Fund. This article is dedicated to May Thielgaard Watts.

1. For a summary of the way the term "scale" is used in ecology, *see* MONICA G. TURNER ET AL., LANDSCAPE ECOLOGY IN THEORY AND PRACTICE 25-30 (2001). The work of ecologists has been done in combination with specialists in many other fields that emphasize large scale analysis. *See, e.g.*, NAT'L ASSESSMENT SYNTHESIS TEAM, U.S. GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE CHANGE IMPACTS ON THE UNITED STATES 76-80 (2001) (discussing biochemistry and biogeography models used to consider ecological impact of

question some of the old theories implanted in popular ideas about ecology and to explore new ideas that raise new concerns about the ways in which humans are affecting nature.

A. Geographic Scale

Advances in the technology of information gathering and processing have enabled ecological scientists to study the natural world on a larger scale than ever before. Where ecologists were once limited to studying an individual bog or a hilltop, they can now study entire regions or continents.[2]

1. Remote Sensing

Data from satellite observations has become increasingly sophisticated and widely available,[3] enabling ecologists to map the characteristics of areas for which field data is sparse,[4] and offering new opportunities to develop techniques for mapping species' range[5] and classifying ecological systems.[6]

Today's satellite maps cover the globe, revealing the distribution of types of ecological systems at increasingly higher resolutions.[7]

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climate change).

2. "Treating each ecosystem individually, as we now do, loses track of important processes and fluxes that occur at the interfaces. Because ecosystems often occur as a patchwork on the landscape, outputs from one system are almost always inputs to another. Only by treating the entire landscape as a system can all of the important system properties be evaluated." Stephen L. Rawlins, *Institutional Capacity to Monitor the Sources and Effects of Environmental Change in Agriculture*, *in* AGRICULTURE, ENVIRONMENT, AND HEALTH: SUSTAINABLE DEVELOPMENT IN THE 21ST CENTURY 261, 276-77 (Vernon W. Ruttan ed., 1994).

3. KRISTIINA A. VOGT ET AL. EDS., ECOSYSTEMS: BALANCING SCIENCE WITH MANAGEMENT 220-23 (1997). The new and projected advances in remote sensing technology using satellites are concisely summarized in NAT'L RESEARCH COUNCIL, ECOLOGICAL INDICATORS FOR THE NATION 34-41 (2000). *See generally* JOHN R. SCHOTT, REMOTE SENSING: THE IMAGE CHAIN APPROACH (1996); PETER A. BURROUGH & RACHAEL A. MCDONNELL, PRINCIPLES OF GEOGRAPHICAL INFORMATION SYSTEMS (2d ed., 1998); Woody Turner et al., *Special Section: Contributions of Remote Sensing to Biodiversity Conservation: A NASA Approach*, 15 CONSERVATION BIOLOGY 832 (2001). For visual examples, visit NASA Goddard Space Flight Center, GSFC on-line News Releases *available at* http://www.gsfc.nasa.gov/gsfc/earth/imaging/landsat.htm (last visited Mar. 7, 2002).

4. *See, e.g.*, Giles M. Foody et al., *Mapping the Biomass of Bornean Tropical Rain Forest from Remotely Sensed Data*, 10 GLOBAL ECOLOGY & BIOGEOGRAPHY 379 (2001). *See generally*, MAPPING THE DIVERSITY OF NATURE (Ronald I. Miller ed., 1994).

5. Bruce A. Stein & Frank W. Davis, *Discovering Life in America: Tools and Techniques of Biodiversity Inventory*, *in* PRECIOUS HERITAGE: THE STATUS OF BIODIVERSITY IN THE UNITED STATES 19, 21-23 (Bruce A. Stein et al. eds., 2000).

6. R.S. Defries & J.R.G. Townshend, *Global Land Cover Characterization from Satellite Data: From Research to Operational Implementation?*, 8 GLOBAL ECOLOGY AND BIOGEOGRAPHY 367 (1999).

7. NAT'L RESEARCH COUNCIL, GRAND CHALLENGES IN ENVIRONMENTAL SCIENCES 25 (2001). The history of the use of remote sensing satellites is summarized *in* Charles Davies et al., *Moving Pictures: How Satellites, the Internet, and International Environmental Law*

Satellite maps provide visual, radar, and infrared images of the land, water, atmosphere, and geophysical images of the shallow subsurface.[8] The current generation of school children are being taught to use geographic information systems in elementary and high schools.[9]

Ecologists are also able to use new technologies to follow the flow of matter and organisms through ecological systems.[10] For example, recent studies have shown for the first time the migration habits of tuna in the Atlantic Ocean,[11] the extent of regrowth of previously cut tropical forest in Amazonia,[12] and increases of woody vegetation in parts of West Africa that were thought to be experiencing desertification.[13]

2. Access to Remote Places

A variety of technologies have increased scientists' abilities to obtain ecological data from places that were until recently inaccessible.[14] "Deep-sea sampling routinely produces cores from both medium and abyssal depths using remotely controlled

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can help Promote Sustainable Development, 28 Stetson L. Rev. 1091 (1999).

8. NAT'L RESEARCH COUNCIL, *supra* note 7, at 33 (2001). For a review of the uses of remote sensing in the analysis of underground conditions, see generally NAT'L RESEARCH COUNCIL, SEEING INTO THE EARTH: NONINVASIVE CHARACTERIZATION OF THE SHALLOW SUBSURFACE FOR ENVIRONMENTAL AND ENGINEERING APPLICATIONS (2000).

9. RICHARD AUDET & GAIL LUDWIG, GIS IN SCHOOLS 5-12 (2000).

10. Global positioning systems operate through transponders attached to objects moving on the earth's surface that report their data to satellites. Davies et al., *supra* note 7, at 1120.

11. *See, e.g.*, John J. Magnuson et al., *Whose Fish are they Anyway?*, 293 SCI. 1267 (2001) (describing use of two new kinds of electronic tags used to track the movement of tuna throughout the Atlantic Ocean).

12. D.S. Alves & D.L. Skole, *Characterizing Land Cover Dynamics Using Multi-Temporal Imagery*, 17 INT'L J. OF REMOTE SENSING 835 (1996) (stating as much as 31% of formerly cut forest is in various stages of regrowth). For other examples of the use of remote sensing in the analysis of deforestation, see Jaboury Ghazoul & Julian Evans, *Deforestation and Land Clearing*, *in* 2 ENCYCLOPEDIA OF BIODIVERSITY 23, 26 (Simon Asher Levin ed., 2001).

13. Thomas J. Bassett & Koli Bi Zuéli, *Environmental Discources and the Ivorian Savanna*, 90 ANNALS OF THE ASS'N OF AM. GEOGRAPHERS 67, 70-71 (2000). "Close inspection by the research community has begun to illuminate the nuances of land-cover dynamics and to challenge the conventional wisdom on a number of fronts." NAT'L RESEARCH COUNCIL, *supra* note 7, at 50. For a discussion of some of the limitations of classifying vegetation zones from satellite data, see VEGETATION MAPPING FROM PATCH TO PLANET 321-28 (Roy Alexander & Andrew C. Millington eds., 2000).

14. Today's field biologist is likely to be carrying a laptop, cell phone, global positioning system, range finder and digital camera. Stein & Davis, *supra* note 5, at 21.

submersibles."[15] Genetic[16] and isotopic tracers[17] are increasingly being used to follow ecological processes in formerly inaccessible situations.[18] For example, the feeding patterns of wide-ranging raptors can now be better analyzed through the use of stable nitrogen isotope analyses of raptor pellets that indicate not only the nature of the raptor's prey but the kind of areas in which the prey were found.[19]

When these techniques are combined with satellite sensing and advanced systems for analyzing geographic information, they make it possible to identify key areas of ecological importance that humans may never have visited.[20] For example, a recent study that compared satellite data with ground-based sampling in remote parts of the Canadian arctic made it possible to map the diversity of plant species in the area with a high degree of accuracy and identify areas of high biodiversity despite the difficulty of obtaining ground access to much of the area.[21] And the ability to map the shallow subsurface of the land using new noninvasive techniques has provided accurate hydrological data never before available that

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15. NAT'L RESEARCH COUNCIL, *supra* note 7, at 25.

16. *See, e.g.*, Alexander Mosseler & O.P. Rajora, *Monitoring Population Viability in Declining Tree Species Using Indicators of Genetic Diversity and Reproductive Success, in* ENVIRONMENTAL FOREST SCIENCE : PROCEEDINGS OF THE IUFRO DIVISION 8 CONFERENCE ON ENVIRONMENTAL FOREST SCIENCE 333, 335-38 (Kyoji Sassa ed., 1998).

17. *See, e.g.*, Eric W. Wolff, *The Record of Aerosol Deposited Species in Ice Cores, and Problems of Interpretation, in* CHEMICAL EXCHANGE BETWEEN THE ATMOSPHERE AND POLAR SNOW 1-14 (Eric W. Wolff & Roger C. Bales eds., 1996) (describing use of tracers in study of Arctic ice cores); Jeffrey F. Kelly et al., *Insights into Wilson's Warbler migration from analyses of hydrogen stable-isotope ratios*, 130 OECOLOGIA 216 (2002). *See generally* DAVID STEVEN SCHIMEL, THEORY AND APPLICATION OF TRACERS (1993).

18. *See* John N. Thompson et al., *Frontiers of Ecology*, 51 BIOSCIENCE 15 (2001). *See, e.g.*, Alves & Skole, *supra* note 12 (comparing land use patterns in Amazonia over five years); D.R. Robinson et al., *Linking Breeding and Wintering Ranges of a Migratory Songbird Using Stable Isotopes*, 295 SCI. 1062 (2002) (migratory patterns of warbler species discerned through examination of feathers of wintering birds and comparing geographic patterns in breeding ground isotopic signatures).

19. Elaine K. Harding & Emiko Stevens, *Using Stable Isotopes to Assess Seasonal Patterns of Avian Predation Across a Terrestrial-Marine Landscape*, 129 OECOLOGIA 436 (2001); *See also* Jeffrey F. Kelley et al., *Insights into Wilson's Warbler Migration from Analyses of Hydrogen Stable-Isotope Ratios*, 130 OECOLOGIA 216 (2002). For other examples, see the case studies found in GENETICS, DEMOGRAPHY AND VIABILITY OF FRAGMENTED POPULATIONS (Andrew G. Young & Geoffrey M. Clarke eds., 2000).

20. The research projects of various federal agencies that are analyzing environmental change are summarized in SUBCOMMITTEE ON GLOBAL CHANGE RESEARCH OF THE COMMITTEE ON ENVIRONMENTAL AND NATURAL RESOURCES OF THE NATIONAL SCIENCE AND TECHNOLOGY COUNCIL, OUR CHANGING PLANET: THE FY 2002 U.S. GLOBAL CHANGE RESEARCH PROGRAM (2001).

21. William Gould, *Remote Sensing of Vegetation, Plant Species Richness, and Regional Biodiversity Hotspots*, 10 ECOLOGICAL APPLICATIONS 1861, 1862 (2000).

will make it possible to follow ecological processes that could otherwise only be estimated.[22]

3. International Networks

The Internet has fostered the creation of increasing numbers of international networks that interchange data relevant to ecological research.[23] For example, a Global Coral Reef Monitoring Network[24] has been established by the Intergovernmental Oceanographic Commission and other agencies.[25] Other examples include the International Geosphere-Biosphere Programme,[26] the Global Population Dynamics Database,[27] and the Millennium Ecosystem Assessment.[28]

The availability of networks such as these has made it possible for scientists all over the planet to participate in joint research and modeling projects that produce results far faster than ever before attempted.[29] The work of the Intergovernmental Panel on Climate Change, which has produced extensive reviews of global climate change at five year intervals using the work of over a thousand scientists, is the most prominent example of the research capabilities of international networks.[30]

Private conservation organizations are also using large-scale ecology in proposals for increased protection of natural areas that

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22. On the mapping of the subsurface, *see generally* NAT'L RESEARCH COUNCIL, SEEING INTO THE EARTH: NONINVASIVE CHARACTERIZATION OF THE SHALLOW SUBSURFACE FOR ENVIRONMENTAL AND ENGINEERING APPLICATIONS (2000).

23. International agreements have attempted to secure the rights of nations from which remote sensing data are obtained to have access to the data. *See* Charles Davies et al., *supra* note 7, at 1107-12 (1999).

24. *See* http://www.icriforum (last visited Sept. 27, 2001)

25. Clive Wilkinson & Bernard Salvat, *The Global Reef Monitoring Network: Reversing the Decline of the World's Reefs*, *in* CORAL REEFS: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT 16, 17-18 (Marea E. Hatziolos et al., eds. 1997).

26. *See* http://www.igbp.kva.se (last visited Mar. 7, 2002). The first report of the IGBP was PLANT FUNCTIONAL TYPES: THEIR RELEVANCE TO ECOSYSTEM PROPERTIES AND GLOBAL CHANGE (T.M. Smith et al. eds., 1997).

27. *See* http://www.cpb.bio.ic.ac.uk (last visited Mar. 7, 2002). *See* Pablo Inchausti & John Halley, *Investigating Long-Term Ecological Variability Using the Global Population Dynamics Database*, 293 SCI. 655 (2001).

28. The United Nations began this program in 2001. *See* http://www.millenniumassessment.org (last visited Mar. 7, 2002). For other United Nations global environmental programs, *see* http://www.unep.org/Geo2000/ (last visited Mar. 7, 2002).

29. For a discussion of a number of European-based networks, see David L. Hawksworth, *The Response of the International Scientific Community to the Challenge of Biodiversity*, *in* NATURE AND HUMAN SOCIETY: THE QUEST FOR A SUSTAINABLE WORLD 347, 347-54 (Peter H. Raven ed., 2000).

30. *See* http://www.ipcc.ch (last visited Mar. 7, 2002). For a detailed review of the IPCC's work as applied to the United States, see NAT'L ASSESSMENT SYNTHESIS TEAM, UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE CHANGE IMPACTS ON THE UNITED STATES: THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE (2001).

extend beyond national borders. The Yellowstone-to Yukon initiative, which seeks to develop wildlife corridors extending through the northern Rocky Mountains and Canada, is a privately-initiated effort that has attracted a great deal of attention and support.[31] Along the border between the United States and Mexico, the Sonoran Institute has been working with Native American tribes and Mexican conservation organizations to develop integrated means of addressing ecological issues in the Sonoran desert and the Colorado River delta.[32] And a privately funded effort has begun an ambitious project called Species 2000 that hopes to inventory the world's 1.75 million known species.[33]

4. Analytical Capacity

Analytic methods are also improving,[34] and rapidly growing computer capacity enables the processing of increasing quantities of information each year.[35] A panel of the National Research Council recently pointed out that advances are continuing to be made toward solving some major methodological problems involved in the analysis of spatial data.[36] Only recently has information technology enabled us to analyze data on such large scales[37] and to

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31. *See* http://www.rockies.ca/y2y/ (last visited Mar. 7, 2002).

32. Jeffrey P. Cohn, *Delta in a Delicate Balance*, AMÉRICAS, October 2001, at 36. *See* C. Luther Propst & Peter W. Culp, *Searching for Cibola: Community-based Environmental Restoration in the Colorado River Watershed*, 42 ARIZ. L. REV. 259 (2000); William Snape III et al., *Protecting Ecosystems Under the Endangered Species Act: The Sonoran Desert Example*, 41 WASHBURN L.J. 14, 28-36, 45-49 (2001). For further information on the Sonoran Institute's work in Mexico, see http://www.sonoran.org/garden/isda.html (last visited Oct. 4, 2001).

33. Andrew Lawler, *Up for the Count?*, 294 SCI. 769 (2001).

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> Remote imagery has provided new access to spatial data. Geographic Information Systems (GIS) have facilitated the handling, analysis and display of spatial data. New theory has provided the means to quantify pattern, test hypotheses against random expectations, and come to grips with complexity and scale. The stage seems set for breakthroughs in the new millennium. (Citations omitted).

R.V. O'Neill, *Theory in Landscape Ecology*, *in* ISSUES IN LANDSCAPE ECOLOGY 1 (John A. Wiens & Michael R. Moss eds., 1999). *See also* BRIAN A. MAURER, GEOGRAPHICAL POPULATION ANALYSIS: TOOLS FOR THE ANALYSIS OF BIODIVERSITY (1994).

35. *See, e.g.*, John Gordon & Jane Coppock, *Ecosystem Management and Economic Development*, *in* THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY 37, 40 (Marian R. Chertow & Daniel C. Esty eds., 1997) (stating that computational advances allow environmental managers to consider a much wider range of variables than was possible even just a few years ago).

36. NAT'L RESEARCH COUNCIL, *supra* note 7, at 52.

37. R.S. Defries & J.R.G. Townshend, *Global Land Cover Characterization from Satellite Data: From Research to Operational Implementation*, 8 GLOBAL ECOLOGY AND BIOGEOGRAPHY 367 (1999).

compare the way that the data change over time.[38] Such comparisons have strengthened our awareness of the dynamic character of ecological systems.[39] For example, the combination of powerful analytical methods and new techniques of tracing genetic material makes it possible to map the spatial distribution of genealogical lineages of organisms and deduce their past movements.[40]

These capabilities are beginning to spread beyond the institutions of the developed countries.[41] There has been a continuing increase in the availability of large scale ecological information in the Southern hemisphere, which was formerly sparse.[42] For example, a recent paper compared and analyzed the geographic ranges of almost three thousand South American birds, identifying the ecological characteristics that were typical of the habitats of those species that were declining in number.[43] And remote sensing is now being used to trace the conditions in which the bacteria that causes cholera is present in the coastal waters of the Bay of Bengal.[44] The importance of the El Niño phenomenon to the ecology and the economies of Southern hemisphere countries has provided a major incentive for further strengthening the scientific capabilities of many of those countries.[45]

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38. STAN MORAIN, GIS SOLUTIONS IN NATURAL RESOURCE MANAGEMENT: BALANCING THE TECHNICAL-POLITICAL EQUATION 307 (1999) (Only recently has it been possible to integrate GIS data into temporal dynamic models successfully); *see, e.g.*, Cecile Cabanes et al., *Sea Level Rise During Past 40 Years Determined from Satellite and in Situ Observations*, 294 SCI. 840 (2001).

39. "A consequence of working at large spatial and temporal scales is a tendency to be impressed by how spatially variable and ephemeral ecological communities are." STEPHEN P. HUBBELL, THE UNIFIED NEUTRAL THEORY OF BIODIVERSITY AND BIOGEOGRAPHY 21 (2001). An understanding of the long-term dynamics of ecosystems is extremely useful to natural resource managers. Jacqueline Lesley Brown, *Preserving Species: The Endangered Species Act Versus Ecosystem Management Regime, Ecological and Political Considerations, and Recommendations for Reform*, 12 J. ENVTL. L. & LITIG. 151, 237-41 (1997).

40. *See* J.C. Avise, *The History and Purview of Phylogeography*, 7 MOLECULAR ECOLOGY 371 (1998).

41. Stuart l. Pimm et al., *Can We Defy Nature's End?*, 293 SCI. 2207, 2208 (2001).

42. Robert M. May, *Conceptual Aspects of the Quantification of the Extent of Biological Diversity*, *in* BIODIVERSITY: MEASUREMENT AND ESTIMATION 13, 18-19 (D.L. Hawksworth ed., 1995).

43. Carsten Rahbek & Gary R. Graves, *Multiscale assessment of patterns of avian species richness*, 98 PROC. NAT'L ACAD. SCI. U.S.A. 4534 (2001) (study using database showing geographic ranges of 2,869 species of birds breeding in South America). For commentary on this and similar studies, see Katherine J. Willis & Robert J. Whittaker, *Species Diversity – Scale Matters*, 295 SCI. 1245 (2002), *available in an enhanced version at* www.sciencemag.org/cgi/content/full/295/5558/1245.

44. Brad Lobitz et al., *Climate and infectious disease: Use of remote sensing for detection of Vibrio cholerae by indirect measurement*, 97 PROC. NAT'L. ACAD. SCI. USA 1438 (2000).

45. *See, e.g.*, Milena Holmgren et al., *El Niño Effects on the Dynamics of Terrestrial Ecosystems*, TRENDS IN ECOLOGY AND EVOLUTION, Feb. 2001, at 89. *See generally* ADVANCES IN HISTORICAL ECOLOGY (William Balée ed., 1998).

B. Temporal Scale

Technology has expanded the ability to study the natural world both backward and forward in time. This enables ecologists to study the past and forecast the future in ways that were impossible a few decades ago.[46]

1. Paleoecology

The current composition, structure and function of an ecological system are, in part, a consequence of events that took place centuries ago.[47] From the beginning, ecologists recognized the importance of linking ecology, geology, and paleontology.[48] Studies of peat bogs provided evidence of layers of different types of vegetation laid down in presumed time series.[49] By the 1920s, ecologists were identifying pollen grains preserved in peat and sediment deposits.[50]

By the 1970s, carbon-14 analysis became a common method of dating specimens, and new techniques of pollen analysis enabled ecologists to operate in all kinds of soils and climates.[51] While earlier ecologists were restricted to snapshots of recent conditions, today the technology for reconstructing ecologies of the distant past make it possible to view the history of the natural world from long-range time perspectives.[52] Paleoecology, as the study of prehistoric ecological conditions is called, has become an important field in its own right.[53]

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46. *See generally Ecology Through Time*, 293 SCI. 623-60 (July 27, 2001),*available at* http://www.sciencemag.org/feature/data/ecology2001.shtml (last visited Mar. 7, 2001).

47. V.H. Dale et al., *Ecological Principles and Guidelines for Managing the Use of Land*, 10 ECOLOGICAL APPLICATIONS 639, 649 (2000).

48. *See generally* James C. Ritchie, *Paleoecology: Status and Prospect, in* QUARTERNARY LANDSCAPES 113 (Linda C.K. Shane & Edward J. Cushing eds., 1991).

49. Thompson Webb III, *Paleoecology, in* 4 ENCYCLOPEDIA OF BIODIVERSITY 451, 457-58 (Simon A. Levin ed., 2001) (time range of sediment cores from lakes or bogs can range from 50 years to millions of years).

50. ROBERT P. MCINTOSH, THE BACKGROUND OF ECOLOGY: CONCEPT AND THEORY 98-104 (1985).

51. *Id.* at 102-04.

52. *See, e.g.*, Mark T. Clementz & Paul L. Koch, *Differentiating Aquatic Mammal Habitat and Foraging Ecology with Stable Isotopes in Tooth Enamel*, 129 OECOLOGIA 461 (2001) (explaining the stable isotope analysis of the tooth enamel of museum specimens can offer insight into the ecology of extinct animals that lived millions of years ago). *See generally* JAMES H. BROWN, MACROECOLOGY 189-91 (1995). For a series of papers oriented toward the research necessary to find evidence for the practice of ecosystem restoration, see THE HISTORICAL ECOLOGY HANDBOOK: A RESTORATIONIST'S GUIDE TO REFERENCE ECOSYSTEMS (David Egan & Evelyn A. Howell eds., 2001).

53. M. TOKESHI, SPECIES COEXISTENCE: ECOLOGICAL AND EVOLUTIONARY PERSPECTIVES 9-11 (1999).

Paleoecological methodology has increased in sophistication in recent years.[54] Analysis of pollen[55] from ancient lake sediments,[56] marine sediments,[57] or ice fields[58] and studies of fossil DNA[59] are examples of scientific methods that were unknown until recently. These methods have been particularly helpful in tracing past climate changes. Fine-resolution sampling of records from ocean sediments, lakes, and ice cores has revealed sudden shifts of climate occurring within years or decades at many different times in the past, suggesting that the climate system can shift much more rapidly than previously assumed.[60] For example, a recent study of coastal ecosystems analyzed data from marine sediments going back about 125,000 years.[61]

2. Long-Term Ecological Records

Although systematic record-keeping for the purpose of ecological research began only in the twentieth century,[62] the passage of time each year gives scientists additional historical records from sources such as accurate wildlife surveys and weather and climate data.[63] As time passes, the trends in such data become more reliable,

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54. For example, chemical analyses of fluids trapped in tiny rocks spaces are being used to reconstruct past climates. Robert H. Goldstein, *Clues from Fluid Inclusions*, 294 SCI. 1009 (2001).

55. Interpretation of pollen data involves establishing the composition of the vegetation that delivered the pollen, and then inferring the climate, ecology and perhaps the human activities that would have generated that mix of vegetation. KNUT FAEGRI & JOHS. IVERSEN, TEXTBOOK OF POLLEN ANALYSIS 115-16 (4th ed., 1989).

56. John P. Smol, *Paleoecology: A Diagnostic Approach to Assessing Ecosystem Health*, *in* ECOSYSTEM HEALTH 210, 210 (David Rapport et al. eds., 1998) (explaining the study of lake histories from sediment profiles is known as paleolimnology).

57. *See, e.g.*, Richard B. Aronson & William F. Precht, *Stasis, Biological Disturbance and Community Structure of a Holocene Coral Reef*, 23 PALEOBIOLOGY 326 (1997) (analyzing the core data showed that recently declining reef species had been dominant for at least 3800 years).

58. *See, e.g.*, Gina E. Hannon et al., *6000 Years of Forest Dynamics in Suserup Skov, a Seminatural Danish Woodland*, 9 GLOBAL ECOLOGY & BIOGEOGRAPHY 101 (2000). ROBERT E. RICKLEFS, THE ECONOMY OF NATURE 579-80 (4th ed., 1996).

59. Laura F. Landweber, *Something Old for Something New: The Future of Ancient DNA in Conservation Biology*, *in* GENETICS AND THE EXTINCTION OF SPECIES 163 (Laura F. Landweber & Andrew P. Dobson eds., 1999).

60. NAT'L RESEARCH COUNCIL, *supra* note 7, at 28-29.

61. Jeremy B.C. Jackson et al., *Historical Overfishing and the Recent Collapse of Coastal Ecosystems*, 293 SCI. 629 (2001).

62. Andrew Sugden & Richard Stone, *Filling Generation Gaps*, 293 SCI. 623 (2001).

63. *See, e.g.*, Jennifer M. Parody et al., *The Effect of 50 Years of Landscape Change on Species Richness and Community Composition*, 10 GLOBAL ECOLOGY & BIOGEOGRAPHY 305 (2001) (comparing 50 years of data on bird observations and land cover for an area of northern lower Michigan); Jason Jones et al., *Assessing the Effects of Natural Disturbance on a Neotropical Migrant Songbird*, 82 ECOLOGY 2628 (2001) (analyzing effect of severe Quebec ice storm on populations of warblers that were being studied).

leading to the reevaluation of many earlier assumptions.[64] For example, analysis of such records has made ecologists aware that evolution of organisms takes place more rapidly than had traditionally been assumed[65] and has cast new light on the influence of climate change.[66]

The National Science Foundation sponsors a series of sites on which a wide variety of ecological information is being maintained over the long term. This Long Term Ecological Research network is the largest single project in ecological research, involving over 1200 scientists and students working on 24 different sites.[67] Other long term data sets of importance to ecological science are being developed by NOAA's Climate Monitoring and Diagnostics Laboratory, the National Aeronautical and Space Administration, the Environmental Protection Agency, and the Department of Energy's Carbon Dioxide Information and Analysis Center.[68]

3. Mining Historical Records

In addition, ecologists have found ways of deriving ecological information from historical records maintained for other purposes, enabling them to reconstruct time series for many species of organisms dating back well into the nineteenth century.[69] A wide variety of organizations have been keeping censuses of particular types of animals for long periods of time.[70] A consortium of universities has assembled a Global Population Dynamics Database that contains more than 4500 time series of population abundance for over 1800 animal species across many geographical locations.[71]

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64. Jocelyn Kaiser, *An Experiment for All Seasons*, 293 SCI. 624 (2001).

65. John N. Thompson, *Rapid Evolution as an Ecological Process*, 13 TRENDS IN ECOLOGY AND EVOLUTION 329 (1998). *See also* Craig Packer et al., *Egalitarianism in Female African Lions*, 293 SCI. 690 (2001).

66. James H. Brown et al., *Complex Species Interactions and the Dynamics of Ecological Systems: Long-Term Experiments*, 293 SCI. 643, 648-49 (2001). For a readable discussion of one biologist's long term ecological experiment and its relationship to climate change, see Darcy Frey, *George Divoky's Planet*, N.Y. TIMES MAG., Jan. 6, 2002, at 24.

67. Kaiser, *supra* note 64, at 624.

68. NAT'L RESEARCH COUNCIL, *supra* note 7, at 18.

69. Sugden & Stone, *supra* note 62, at 623.

70. For example, the National Audubon Society has records of Christmas bird counts for over a century. The first Christmas Bird Counts (CBCs) were conducted in 1900 in response to a suggestion made in the National Audubon Society's magazine, and the survey has been coordinated by the National Audubon Society ever since and has become the oldest continuous wildlife survey in North America. *See* http://www.mp1-pwrc.usgs.gov/birds/cbc.html (last visited Sept. 17, 2001). Because of the popularity of birds, historical data on their breeding and movements is better than for other animals. Stein & Davis, *supra* note 5, at 38.

71. Pablo Inchausti & John Halley, *Investigating Long-Term Ecological Variability Using the Global Population Dynamics Database*, 293 SCI. 655 (2001).

The database contains records of the prevalence of 544 series of animal species for periods of thirty years or more.[72] Museum specimens collected at various times in the past also provide opportunities to trace changes in the genetic makeup of organisms over time.[73]

In addition, ecologists are finding old ecological information in surprising locations. For example, one recent research project analyzed the use of "witness-trees" in early American surveys to describe presettlement forest vegetation.[74] A European study examined old pictures on postcards to trace the history of vegetation changes in particular areas.[75] Another project examined New England newspapers and other records dating back to the 17th century to determine the timing and ecological impact of hurricanes that had hit New England.[76]

4. Phylogenetics

Moreover, new molecular biology techniques make it possible to reconstruct the ways in which organisms evolved, throwing new light on some traditional taxonomies.[77] A panel of the National Research Council reported that:

> Genomics using polymerase chain reaction (PCR) and microarrays can now be used for rapidly and efficiently assessing genotypic diversity and variation in gene expression. Molecular tools for characterizing microbial diversity reveal vast stores of hidden diversity in oceans, sediments, and soils, including environments at extremes of temperature and pressure. These methods will lead to new insights into the significance and consequences of

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72. *Id.* at 656. The database is continually updated and can be accessed at http://www.cpb.bio.ic.ac.uk (last visited Sept. 6, 2001).

73. *See, e.g.*, Marie L. Hale et al., *Impact of Landscape Management on the Genetic Structure of Red Squirrel Populations*, 293 SCI. 2246 (2001) (DNA tests on museum specimens of various ages show how increasing forest connectivity over time improved gene flow through metapopulation).

74. Bryan A. Black & Marc D. Abrams, *Influences of Native American and Surveyor Biases on Metes and Bounds Witness-Tree Distribution*, 82 ECOLOGY 2574 (2001).

75. Max Debussche et al., *Mediterranean Landscape Changes: Evidence From Old Postcards*, 8 GLOBAL ECOLOGY & BIOGEOGRAPHY 3 (1999).

76. Emery R. Boose et al., *Landscape and Regional Impacts of Hurricanes in New England*, 71 ECOLOGICAL MONOGRAPHS 27, 30 (2001).

77. *See, e.g.*, James E. Richardson et al., *Rapid and Recent Origin of Species Richness in the Cape Flora of South Africa*, 412 NATURE 181 (2001) (using DNA sequence data to determine that the wide variety of species in the Cape region resulted from relatively recent speciation).

> diversity below the species level, as well as better understanding of species diversity.[78]

As one group of biologists recently put it, "The luxury of now having more basic natural history data across taxa, at the same time that our reconstructions of phylogenetic history are precise and reliable, almost gives optimism for countering daily extinction rates."[79]

5. Modeling the Future

The time scales needed to analyze ecological functions vary greatly.[80] Increased computer modeling power enables ecologists to project future conditions at whatever time scale is needed to capture the rate of change of a particular ecological process,[81] which may range from "minutes to millennia."[82] Modern computer models enable ecologists to project future conditions at any of these time scales, and while the complexity of ecological systems makes the predictive value of many such models somewhat speculative,[83] the modeling allows scientists to think in expanded ways that were not feasible for an earlier generation.[84] For example, the National Park Service and the United States Geological Survey study a Regional Hydro-Ecological Simulation System to evaluate future resource

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78. NAT'L RESEARCH COUNCIL, *supra* note 7, at 25.

79. J.L. Gittleman et al., *Detecting ecological pattern in phylogenies, in* BIODIVERSITY DYNAMICS: TURNOVER OF POPULATIONS, TAXA, AND COMMUNITIES 51, 64-65 (Michael L. McKinney & James A. Drake eds., 1998).

80. "Rates of carbon uptake and water loss through stomata can be measured and are expressed in seconds; growth, however, is measured in days to weeks; and life history characteristics in generations that can take place in periods of a year or less or may take tens and even hundreds of years." O.T. Solbrig, *Plant Traits and Adaptive Strategies: Their Role in Ecosystem Function, in* BIODIVERSITY AND ECOSYSTEM FUNCTION 97, 107 (Ernst-Detlef Schulze & Harold A. Mooney eds., 1994).

81. James S. Clark et al., *Ecological Forecasts: An Emerging Imperative,* 293 SCI. 657 (2001).

82. For example, in a grassland the time scales of key ecological processes are: (1) precipitation: minutes to hours; (2) transpiration: hours to days; (3) forage production: days to months; (4) species composition changes: months to years; (5) soil formation: years to centuries; (6) geomorphic change: centuries to millennia. Paul G. Risser, *Landscape Ecology: State of the Art, in* LANDSCAPE HETEROGENEITY AND DISTURBANCE 3, 10 (Monica Goigel Turner ed., 1987)

83. NAT'L RESEARCH COUNCIL, *supra* note 7, at 23 (dynamic global vegetation models attempt to simulate habitat distribution based on competition among the major functional types of plants, but our limited understanding of the factors that control such competition make the results tentative). *See* MICHAEL J. G. VAN EETEN & EMERY ROE, ECOLOGY, ENGINEERING AND MANAGEMENT 75-77 (2002) (ecological models have many problems but are steadily improving).

84. *Id.* at 57.

conditions in Glacier National Park under various climate scenarios.[85]

C. A Greater Vision

Current research in large-scale ecology offers interesting lessons that should be useful in fashioning the environmental laws of the twenty-first century.[86] The greater vision scientists have obtained through large scale ecology[87] has turned some earlier ideas that much of the public thought were "eternal truths" into variables, which apply only under certain time and space conditions. First, the old cliché "the survival of the fittest" is not going to leave us with a world populated solely by cockroaches and rats. Competition, in combination with evolution and environmental change, should produce some increases in biodiversity. But in some cases, particularly on islands, competition from invasive species can be both an ecological and economic hazard.[88]

Second, the assumption that "fragmentation of habitat" is always evil is unsound. In many situations, a mosaic of small patches of differing habitats provides ecological processes that are essential to the survival of many types of organisms. There are some situations, particularly where there are large blocks of forest, where the destruction of the forest at current rates threatens the collapse of ecological systems and the loss of diversity, but the threat is from the scale of habitat destruction far more than from the process of fragmentation.[89]

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85. Daniel B. Fagre, *Understanding Climate Change Effects on Glacier National Park's Natural Resources*, *in* U.S. GEOLOGICAL SURVEY, STATUS AND TRENDS OF THE NATION'S BIOLOGICAL RESOURCES, *at* http://biology.usgs.gov/s+t/SNT/noframe/c1111.htm (last visited Dec. 4, 2001).

86. *See generally* Jacqueline Lesley Brown, *Preserving Species: The Endangered Species Act Versus Ecosystem Management Regime, Ecological and Political Considerations, and Recommendations for Reform*, 12 J. ENVTL. L. & LITIG. 151, 237-41 (1997). Advances in large scale ecology affect conservation organizations as well as government agencies. For example, the Nature Conservancy says that a "new appreciation of the importance of broad-scale ecological and evolutionary processes to conservation gives new impetus to increasing the geographic and temporal scale of our conservation efforts." Jonathan S. Adams et al., *Biodiversity: Our Precious Heritage*, *in* PRECIOUS HERITAGE: THE STATUS OF BIODIVERSITY IN THE UNITED STATES 3, 16 (Bruce A. Stein et al. eds., 2000).

87. The *increase* in scale is not the only important advance in ecological science. Small-scale ecology is also unveiling new vistas. Molecular biology and microbiology have opened up new frontiers of knowledge–including an increased awareness of the mutualistic or symbiotic relationship of many forms of life–but that is the not within the scope of this article. For a recent and readable analysis of some of this research, see TOM WAKEFORD, LIAISONS OF LIFE (2001).

88. *See infra* Section III.A.

89. *See infra* Section III.B.

Third, the concept of "natural disaster" needs to be reevaluated. Many disturbances are natural processes that have played important roles over time in maintaining cycles of environmental release and renewal. Seen from a large spatio-temporal perspective, many of the patterns of change in the natural environment seem to be more cyclical than previously realized.[90] These cycles include "disturbance" phases that we have previously characterized as natural disasters such as fire, flood, and pest outbreak. Some changes in the landscape that we thought were irreversible may actually be inevitable and useful parts of the natural cycle of change.[91] As long as the disturbance can be kept within historical parameters, ecological systems can adjust to storms, fire, disease, and other disturbance. But when humans cause disturbance outside the framework of historical precedent, the results are unpredictable.[92]

This leads, finally, to the conclusion that if humans can keep their alteration of nature within parameters that ecological systems have experienced in the past, the systems are likely to retain existing ecological functions over broad scales of time and place. The key question is whether scientists can identify the limits beyond which we risk ecological collapse, and whether we can develop laws and policies that will keep us within those limits.[93]

In essence, this means that we need to be able to tell the difference between (1) human activities that merely imitate cyclical changes to which ecological systems are prepared to adapt, and (2) human activities that cause linear, unidirectional, continuous change that takes us into realms beyond the experience of ecological systems.[94] I am optimistic that the rapid pace of ecological research will increasingly be able to draw that metastability line, but I am less sanguine about our ability to keep ourselves from crossing it.

Armed with this scientific knowledge, resource managers are trying to rethink their management techniques to better cope with these cycles. We can hope to cope with cyclical changes in the natural world through a better understanding of ecological processes. But some of the changes humans are causing seem to be

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90. ROBERT M. MAY, *Introduction to the Princeton Landmarks in Biology Edition*, *xi*, *xiv-xvii*, STABILITY AND COMPLEXITY IN MODEL ECOSYSTEMS (2001) (long runs of time-series data needed to sort out cyclical ecological patterns from chaotic patterns). *See, e.g.*, J.E. Hewitt et al., *Assessing environmental impacts: Effects of spatial and temporal variability at likely impact scales*, 11 ECOLOGICAL APPLICATIONS 1502 (2001) (noting difficulty of assessing impact under conditions of spatial and temporal variability).

91. SIMON A. LEVIN, FRAGILE DOMINION: COMPLEXITY AND THE COMMONS 114-15 (1999).

92. *See infra* Section III.C.

93. *See infra* Section III.D.

94. *See infra* text accompanying notes 432-46.

unidirectional rather than cyclical. The rate of increase of nitrogen in the water[95] and carbon dioxide in the air,[96] for example, seem to be steady and inexorable. The first generation of environmental laws sought to ameliorate human activities that were making highly visible changes in the natural environment that seemed irreversible. Today, however, the gradual, insidious and seemingly inexorable change caused by human activities such as nitrogen deposition and greenhouse gas emission are among the most serious problems. Unless we can counteract such trends, we may be venturing into areas beyond the ability of science to foresee the effect on the natural world.[97]

Section II of this article will summarize some of the theoretical premises on which large scale ecology is based. Section III will review some of the most interesting results of current research in large-scale ecology. Section IV will suggest some ways in which the results of this research could usefully be applied by lawmakers.

II. PREMISES OF LARGE-SCALE ECOLOGY

The term "ecology" appears so loosely[98] in general usage that the public sometimes tends to overlook the fact that ecology is a specific field of study within the biological sciences. Ecologists tend to subdivide their field by level of organization; ecologists' subdisciplines focus on individual organisms, populations, communities, ecosystems, or landscapes.[99] A landscape is a cluster or "mosaic" of interacting ecological systems,[100] and the branch of ecology known as "landscape ecology" studies the ecological effects of this patterning.[101] Ecologists, like all scientists, have their

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95. *See infra* text accompanying notes 492-512.

96. *See infra* text accompanying notes 457-89.

97. *See infra* text accompanying notes 531-59.

98. The popular media often use "ecology" to refer to anything that smells vaguely green to them. And radical ideologues have coined the term "deep ecology" as the name for a political movement that seeks to eliminate anthropocentric behavior. *See* ARRAN E. GARE, POSTMODERNISM AND THE ENVIRONMENTAL CRISIS 86-96 (1995); *see generally* DEEP ECOLOGY (Michael Tobias ed., 1985).

99. Richard J. Hobbs, *Managing Ecological Systems and Processes*, *in* ECOLOGICAL SCALE: THEORY AND APPLICATIONS 459, 464-65 (David L. Peterson & V. Thomas Parker eds. 1998) (defining terms).

100. Anthony W. King, *Hierarchy Theory: A Guide to System Structure for Wildlife Biologists*, *in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 185, 205-06 (John A. Bissonette ed., 1997).

101. For a concise summary of the scope of current landscape ecology, see Steward T.A. Pickett and M. L. Cadenasso, *Landscape Ecology: Spatial Heterogeneity in Ecological Systems*, 269 SCI. 331 (1995). *See also* David W. Burnett, *New Science but Old Laws: The Need to Include Landscape Ecology in the Legal Framework of Biodiversity Protection*, 23 ENVIRONS ENVTL. L. & POL'Y J. 47 (Fall 1999).

internal disagreements, and some prefer the term "macroecology"[102] over "landscape ecology," and still others treat all large-scale ecology within the definition of "ecosystem ecology."[103] I will use the general term "large-scale" to describe ecological research at scales larger than those typically used in population ecology or community ecology. "Large-scale ecology" is a descriptive term that does not seem to carry any academic jurisdictional baggage.[104]

A number of hypotheses have arisen out of, or been strongly influenced by, the study of ecological processes at large-scales. Some of these have developed a strong body of influential support. In this part of the article I will describe those that seem to have the most relevance to the development of law and policy.

A. Ecosystems are Human-Generated Concepts

Ecological science has used today's technology for processing large amounts of information to put together visions of the natural world at a much larger scale than was previously possible. Although ecology still gains many insights from analysis of small-scale phenomena, large-scale ecology is beginning to make us realize that ecological systems are more than just the sum of their parts.[105] Large-scale ecology gives us a view of the world in which the concept of the "ecosystem," which dominated the vocabulary of popular environmentalism for decades,[106] is giving way to more nuanced ideas.[107]

Ecologists now recognize that each of the rules that govern the ecological processes operates at its own scale. We cannot arbitrarily select any boundary for an ecosystem in space and time nor assume that the rules for that ecosystem operate within, and only within,

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102. BROWN, *supra* note 52; KEVIN J. GASTON & TIM M. BLACKBURN, PATTERN AND PROCESS IN MACROECOLOGY (2000); BRIAN A. MAURER, UNTANGLING ECOLOGICAL COMPLEXITY: THE MACROSCOPIC PERSPECTIVE (1999). Macroecologists try to bring together such separate disciplines as systematics, ecosystem ecology, paleontology, and community ecology. Brian A. Maurer, *Macroecology and Consilience*, 9 GLOBAL ECOLOGY & BIOGEOGRAPHY 275 (2000).

103. For concise definitions of the various branches of landscape ecology, see John A. Wiens, *Metapopulation Dynamics and Landscape Ecology*, *in* METAPOPULATION BIOLOGY: ECOLOGY, GENETICS AND EVOLUTION 43, 45 (Ilkka Hanski & Michael E. Gilpin eds., 1997).

104. *See* Robert M. May, *The Effects of Spatial Scale on Ecological Questions and Answers*, *in* LARGE-SCALE ECOLOGY AND CONSERVATION BIOLOGY 1 (P.J. Edwards et al. eds., 1993). Not all of the ecologists whom I have cited in support of these propositions would necessarily label themselves as "large-scale" ecologists, but the boundaries of the subspecialties of ecology are notoriously fuzzy.

105. LEVIN, *supra* note 91, at 17-38.

106. FRANK BENJAMIN GOLLEY, A HISTORY OF THE ECOSYSTEM CONCEPT IN ECOLOGY, 117-18, 175-76 (1993).

107. S.T.A. Pickett & M.L. Cadenasso, *The Ecosystem as a Multidimensional Concept: Meaning, Model, and Metaphor*, 5 ECOSYSTEMS 1 (2002); Stein & Davis, *supra* note 5, at 47-49 (there is no consensus on any single method for mapping ecological communities).

that boundary.[108] Ecological topology, as some scientists call it, is more complex than that, which makes its study challenging, but also makes it more realistic.[109] In other words, we need not define ecosystem the same way for the warbler and the eagle.[110]

For example, in the central United States we have begun to refer to areas of mixed trees and grassland as "savannas," a type of habitat that had not been thought to exist in the area until recently.[111] Should we call this type of habitat an ecosystem, or should we call it an "ecotone" – the term used to describe the boundary between two ecosystems?[112] What may appear as a relatively discrete boundary at one scale may look more like a continuous gradient at finer levels of resolution.[113] Does it really matter, unless we arbitrarily choose to target only something we legally define as an "ecosystem" for analysis and protection?[114]

1. Ecological Systems Are Open to Outside Influences

Contemporary ecologists assume that ecosystems are *open* – in other words, that they are susceptible to outside influences.[115] Most early ecological studies assumed that the ecological systems

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108. DAN R. PERLMAN & GLENN ADELSON, BIODIVERSITY: EXPLORING VALUES AND PRIORITIES IN CONSERVATION 105 (1997) ("the geographic landscape contains no unambiguous boundaries.").

109. Thompson et al., *supra* note 18.

110. John A. Wiens, *Habitat Fragmentation: Island v. Landscape Perspectives on Bird Conservation*, 137 IBIS S97, S98 (1994). *See* Risser, *supra* note 82, at 8-9 ("Each species views the landscape differently, and what appears as homogeneous patch to one may comprise a very heterogeneous patchy environment to another); ALMO FARINA, LANDSCAPE ECOLOGY IN ACTION 16-19 (2000) (animals perceive landscape through fixed genetic cues and accumulated experience).

111. WILLIAM K. STEVENS, MIRACLE UNDER THE OAKS 87-91 (1995). Although most ecologists reserve the use of the term ecosystem to a particular parcel of land, the term is often popularly applied to the characteristics of particular types of land, such as "wetland ecosystems." PERLMAN & ADELSON, *supra* note 108, at 111-14.

112. John B. Taft, *Savanna and Open-Woodland Communities*, *in* CONSERVATION IN HIGHLY FRAGMENTED LANDSCAPES 24 (Mark W. Schwartz ed., 1997). Some biologists are uncomfortable with the term "habitat" as well, probably because it originated in relation to hunting and fishing laws that failed to take into account non-game species. *See* JAMES F. BERRY & MARK S. DENNISON, THE ENVIRONMENTAL LAW AND COMPLIANCE HANDBOOK 669-70 (2000).

113. Jerzy Solon, *Integrating Ecological and Geographical (Biophysical) Principles in Studies of Landscape Systems*, *in* ISSUES IN LANDSCAPE ECOLOGY 22, 23 (John A. Wiens & Michael R. Moss eds., 1999).

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

115. "Ecosystems are open to flows of energy, elements, and biota." Judy L. Meyer, *Conserving Ecosystem Function*, *in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 136, 138 (Steward Pickett et al. eds., 1997). *See also* V. Thomas Parker & S.T.A. Pickett, *Restoration as an Ecosystem Process: Implications of the Modern Ecological Paradigm*, *in* RESTORATION ECOLOGY AND SUSTAINABLE DEVELOPMENT 17, 22 (Krystyna M. Urbanska et al. eds., 1997).

analyzed had a relatively uniform structure and that the processes that created the structure were relatively uniform in space; thus they could treat each ecosystem as a closed and self-sufficient system.[116] Today we recognize that "neither boundaries on maps nor fences in the real world hold back" outside influences on ecological systems.[117]

Earlier ecologists often hoped to find that ecosystems had natural boundaries, but today's ecologists recognize that all ecological systems are somewhat flexible artifacts that we define for purpose of facilitating the study and management of natural areas.[118] Ecosystems must be defined in terms of their "scale," i.e., their location in space and time.[119] Large scale ecologists study the interrelationships between the biotic structure of an ecological system as well as its physical environment and setting within the landscape.[120] From that vantage point, the description of the boundaries of a particular ecosystem may seem quite arbitrary since it is apparent that all of the ecosystems are interrelated.[121]

2. Ecological Systems Are Complex

The various elements of ecological systems are interrelated in complex ways and the degree of complexity is increasing over time.[122] The structural complexity of ecological systems is closely

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116. Steward T.A. Pickett & Kevin H. Rogers, *Patch Dynamics: The Transformation of Landscape Structure and Function, in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 101, 102 (John A. Bissonette ed., 1997). The famous early twentieth-century ecologist Frederic Clements believed that science could identify ecological units that had the properties of organisms, a theory that has since fallen into disrepute but may have influenced the development of the idea that ecosystems had fixed boundaries defined by nature rather than by the human analyst. Giulio A. De Leo & Simon Levin, *The Multifaceted Aspects of Ecosystem Integrity*, 1 CONSERVATION ECOLOGY (1997), *available at* http://www.consecol.org/vol1/iss1/art3.

117. Pickett & Rogers, *supra* note 116, at 119. *See also* Solon, *supra* note 113, at 24 (each organism defines a mosaic of habitat or resource patches differently and on different scales).

118. The concept of an ecological community is threatening to become "an idea as likely to generate confusion as enlightenment." L.B. Slobodkin, *Limits to Biodiversity (Species Packing), in* 3 ENCYCLOPEDIA OF BIODIVERSITY 729, 735 (Simon Asher Levin ed., 2001).

119. For a categorization of the various approaches to scale used by ecologists, see David L. Peterson & V. Thomas Parker, *Dimensions of Scale in Ecology, Resource Management and Society, in* ECOLOGICAL SCALE: THEORY AND APPLICATIONS 499, 503-07 (David L. Peterson & V. Thomas Parker eds., 1998).

120. Parker & Pickett, *supra* note 115, at 20.

121. LEVIN, *supra* note 91, at 71 ("[W]hat we call a community or ecosystem is often a fiction, an arbitrary restriction of spatial boundaries rather than a reflection of real thresholds of species change.").

122. BROWN, *supra* note 52, at 202 (1995) (concluding that there is a trend toward increasing complexity of all of the individuals, societies, and species that make up the global biota.). *See also* C.S. Holling et al., *Science, Sustainability and Resource Management, in* LINKING SOCIAL AND ECOLOGICAL SYSTEMS: MANAGEMENT PRACTICES AND SOCIAL MECHANISMS FOR BUILDING RESILIENCE 342, 350-52 (Fikret Berkes et al. eds., 1998).

linked to other ecological processes.[123] In any complex system, the fine details of the system may be linked to large outcomes; the favorite metaphor is the flapping of a butterfly's wings that leads to a hurricane.[124]

Modern complexity theory suggests that the non-linear nature of interrelationships within complex systems requires new analytical processes.[125] Many large-scale ecologists believe that the chaotic nature of ecological processes[126] requires analysis of natural systems from extensive geographic and temporal perspectives.[127] From large space and time scales, the regularity of chaotic systems often emerges in patterns that cannot be seen at smaller scales.[128]

3. Ecological Systems Are Hierarchical

Ecologists increasingly endorse what they call the "hierarchy theory" of ecology.[129] When ecologists refer to the relationships among ecological systems as "hierarchical,"[130] they mean that ecological systems appear to be "hierarchically" structured as a natural consequence of the operation of evolution on the underlying thermodynamic processes by which ecological systems receive and

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123. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF FEDERAL ACTIVITIES, CONSIDERING ECOLOGICAL PROCESSES IN ENVIRONMENTAL IMPACT ASSESSMENTS 31-36 (1999).

124. VALERIE AHL & T.F.H. ALLEN, HIERARCHY THEORY: A VISION, VOCABULARY, AND EPISTEMOLOGY 11 (1996).

125. LEVIN, *supra* note 91, at 69 ("Nonlinearity means that one must examine evolution as a set of problems in game theory: a winning type is not necessarily the best of all solutions, judged against some absolute standard; rather, it is a type that, once established in the population, cannot be displaced . . . . It assumes that the broad outlines of evolutionary adaptation in the face of environmental change may be predictable. But the details are not."). For a critique of complexity theory by a prominent biologist, see EDWARD O. WILSON, CONSILIENCE: THE UNITY OF KNOWLEDGE 85-95 (1998). For a leading historian's perspective, see Donald Worster, *The Ecology of Order and Chaos*, *in* OUT OF THE WOODS: ESSAYS IN ENVIRONMENTAL HISTORY 3, 13-17 (Char Miller & Hal Rothman eds., 1997).

126. In a chaotic model, small differences in initial conditions can lead to radically different outcomes quite quickly. AHL & ALLEN, *supra* note 124, at 5-7. For a discussion of chaos and complexity theories in relation to ecological systems, see J.B. Ruhl, *Thinking of Environmental Law as a Complex Adaptive System: How to Clean Up the Environment by Making A Mess of Environmental Law*, 34 HOUS. L. REV. 933, 945-47 (1997); Gerald Andrews Emison, *The Potential for Unconventional Progress: Complex Adaptive Systems and Environmental Quality Policy*, 7 DUKE ENVTL L. & POL'Y F. 167 (1996).

127. Howard V. Cornell & Ronald H. Karlson, *Local and Regional Processes as Controls of Species Richness*, *in* SPATIAL ECOLOGY: THE ROLE OF SPACE IN POPULATION DYNAMICS AND INTERSPECIFIC INTERACTIONS 250, 252-53 (David Tilman & Peter Kareiva eds., 1997).

128. MAURER, *supra* note 102, at 35. Ecological patterns observed at a single scale often do not extrapolate to other scales. Kevin J. Gaston & Tim M. Blackburn, *A Critique for Macroecology*, 84 OIKOS 353, 355 (1999).

129. Jianguo Wu & Orie L. Loucks, *From Balance of Nature to Hierarchical Patch Dynamics: A Paradigm Shift in Ecology*, 70 Q. REV. BIOLOGY 439 (1995); AHL & ALLEN, *supra* note 124.

130. King, *supra* note 100, at 190-98.

transform solar energy.[131] The term "hierarchy" is perhaps an unfortunate one in view of its connotations of dominance and subservience,[132] but ecologists are not using it in that sense; instead, it refers to the separate, but interrelated, layers and phases by which ecological systems can be classified.[133]

Hierarchy theory posits that ecological systems should not be viewed from a single window or observation set.[134] The complexity of ecological systems can be understood only by analysis from a variety of scales, both geographic and temporal.[135] As the National Research Council recently opined, "Over the past decade, ecologists have gained an awareness of the critical importance of scale."[136] This means that no ecosystem can be arbitrarily defined in space or time.[137] Instead, it must be defined relative to the scale of the issue being analyzed.[138] Within a forest, for example,[139] a particular

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131. R.V. O'NEILL ET AL., A HIERARCHICAL CONCEPT OF ECOSYSTEMS 101-04 (1986).

132. C.S. Holling & Steven Sanderson, *Dynamics of (Dis)harmony in Ecological and Social Systems*, *in* RIGHTS TO NATURE: ECOLOGICAL, ECONOMIC, CULTURAL, AND POLITICAL PRINCIPLES OF INSTITUTIONS FOR THE ENVIRONMENT 57, 77-79 (Susan Hanna et al. eds., 1996).

133. *See* EUGENE P. ODUM, ECOLOGY AND OUR ENDANGERED LIFE-SUPPORT SYSTEMS 25 (1993). "Hierarchy theory . . . does not involve causal mechanisms that work from the top down, but rather posits complex communication both upward and downward across all levels." *See* Bryan Norton, *Change, Constancy, and Creativity: The New Ecology and Some Old Problems*, 7 DUKE ENVTL L. & POL'Y. F. 49, 64 (1996). *See also* C.S. Holling, *Understanding the Complexity of Economic, Ecological, and Social Systems*, 4 ECOSYSTEMS 390, 392-93 (2001) (each level of an ecological system is protected from above by slower, larger levels, but also invigorated from below by faster, smaller cycles of innovation).

134. "Ecosystem processes operate over a wide range of spatial and temporal scales, and . . . [t]here is no single appropriate scale or time frame for management." Norman L. Christensen et al., *The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management*, 6 ECOLOGICAL APPLICATIONS 665, 669 (1996). The scales detected by a bird, elk, gopher, or beetle would be very different. Wu & Loucks, *supra* note 129, at 446. "It is probably no accident that hierarchy theory has emerged in the same intellectual climate that spawned deconstructionist perspectives, for both open the door to unexpected levels of analysis." AHL & ALLEN, *supra* note 124.

135. *See* John A. Bissonette, *Scale-Sensitive Ecological Properties: Historical Context, Current Meaning*, *in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 3, 13-17 (John A. Bissonette ed., 1997).

136. NAT'L RESEARCH COUNCIL, *supra* note 3, at 54.

137. *See* Robert Costanza et al., *Modeling Complex Ecological Economic Systems*, 43 BIOSCIENCE 545, 548-49 (1993); Dale et al., *supra* note 47, at 649.

138. O'NEILL ET AL., *supra* note 131, at 85-86. The hierarchy theory of ecology has been described as a way of making it possible to work with "middle number systems" that have traditionally been impossible to predict.

> You can predict a planetary orbit because this is a small-number system of sun and planet. You can predict the weight of a volume of air because this is a large-number system of very many particles. But you cannot predict the weather next week, much less next year, because this is a complex, middle-number system . . . . There are many interacting parts, too many to analyze one at a time, too few to just average. With hierarchy theory, by selecting a specific observation set and locating

stand of trees may be an appropriate level on which to measure the response of soil microbes to short-term weather, but a whole watershed might be needed to recognize patterns of reproduction of trees in relation to twenty-year precipitation cycles, while a study of regrowth after hurricanes might require the study of an entire region.[140] Harvard ecology professor Richard Forman has suggested that with our growing ability to investigate larger time and space scale, "[i]t is unethical to consider an area in isolation from its surroundings or from its development over time."[141]

Hierarchy theory focuses on ecological system dynamics.[142] It recognizes that in our observations of nature: (1) "every measuring or modeling effort takes place from some specified viewpoint, and a scale must be specified from that viewpoint"; (2) spatial and temporal scales are correlated, in that "smaller subsystems change more rapidly than do the larger systems in which they are embedded"; and (3) "the dynamics of nature are sufficiently distinct that different levels can be described in relatively discrete terms."[143]

> within that set distinct scales that allow you to divide the many parts into levels, . . . [y]ou can develop a small-number explanation within the level.

Robert V. O'Neill & Anthony W. King, *Homage to St. Michael; or, Why Are There So Many Books on Scale?*, *in* ECOLOGICAL SCALE: THEORY AND APPLICATIONS 3, 13-14 (David L. Peterson & V. Thomas Parker eds., 1998).

139. For a specific example, see table 4 in C.S. Holling, *Cross-Scale Morphology, Geometry, and Dynamics of Ecosystems*, 62 ECOLOGICAL MONOGRAPHS 447, 479 (1992).

140. *See* O'NEILL ET AL., *supra* note 131, at 85-91. Similarly, the ecological processes that shape the North American prairie appear to be very different depending on the scale from which the processes are viewed.

> At relatively large scales, climatic features such as precipitation and precipitation-soil interaction sort the pool of prairie species into different groupings. In the eastern reaches of the prairie, the presence or absence of fire sorts between prairie and forest dominance, but at finer scales throughout the biome, the frequency of fire sorts prairie species into different assemblages. Local-scale differentiation among prairie species can be effected by large grazers, small disturbances such as . . .(badger) mounds, differentiation in use by pollinators, and competition. All the processes that sort prairie species are characterized by different scales of frequency, duration and magnitude.

V. Thomas Parker & Steward T.A. Pickett, *Historical Contingency and Multiple Scales of Dynamics Within Plant Communities*, *in* ECOLOGICAL SCALE: THEORY AND APPLICATIONS 171, 189-90 (David L. Peterson & V. Thomas Parker eds., 1998) (citations omitted).

141. Richard T.T. Forman, *The Ethics of Isolation, the Spread of Disturbance, and Landscape Ecology*, *in* LANDSCAPE HETEROGENEITY AND DISTURBANCE 213, 227 (Monica Goigel Turner ed., 1987)

142. *See* C.S. Holling, *New Science and New Investments for a Sustainable Biosphere*, *in* INVESTING IN NATURAL CAPITAL: THE ECOLOGICAL ECONOMICS APPROACH TO SUSTAINABILITY 57, 65 (AnnMari Jansson et al. eds., 1994).

143. Bryan G. Norton, *A Scalar Approach to Ecological Constraints*, *in* ENGINEERING WITHIN ECOLOGICAL CONSTRAINTS 45, 52 (Peter C. Schulze ed., 1996). *See also* Holling, *supra* note 139, at 452.

Larger ecological systems "1) behave at relatively low frequencies, 2) behave with less integrity, 3) offer context, and therefore 4) constrain lower entities."[144]

In many instances, ecologists refer to ecological systems as "nested" within other systems of larger scale.[145] Typically, ecologists study not only the "focal level," the level at which the process or phenomenon being studied operates, but at least the levels above and below. "The higher level provides a context and imposes top-down constraints" on the levels below, while the lower level provides mechanisms by which ecological processes operate, and those mechanisms may impose "bottom-up" constraints.[146] While study of the life history of an individual plant or animal (known as "autecology"[147]) may give us valuable information, only multi-level studies can help us learn the principles[148] that determine whether populations of such organisms can maintain themselves.[149]

B. Natural Areas Contain Internal Mechanisms for Change

One of the most interesting aspects of the large scale ecologist's perspective on nature is the appreciation of how ecological systems change over time by adapting to new environmental conditions in an evolutionary fashion without any overall objective except the pursuit of continuing fitness by the various animals and plants that comprise the system.[150]

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144. AHL & ALLEN, *supra* note 124, at 107. *See also* Holling, *supra* note 133.

145. King, *supra* note 100, at 190; Wu & Loucks, *supra* note 129, at 459. *See generally* Wade B. Worthen, *Community Composition and Nested-Subset Analyses: Basic Descriptors for Community Ecology*, 76 OIKOS 417 (1996).

146. Wu & Loucks, *supra* note 129, at 451. For a discussion of the problems caused by failure to evaluate nestedness, see Worthen, *supra* note 145.

147. A DICTIONARY OF ECOLOGY 36 (Michael Allaby ed., 2d ed. 1998) (defining autecology as the "ecology of individual organisms and populations").

148. Landscape ecologists Jim Sanderson and Larry Harris cite examples of the kind of fundamental processes that govern these interrelationships: (1) "Generalist species are more likely to be found along edges or ecotones that are avoided by specialist species"; (2) "Processes within landscape fragments are affected by processes acting in proximate fragments. The impact of the effect extends beyond the boundary of the fragment and depends upon the strength of the process"; (3) "Corridors increase population persistence in fragmented landscapes"; and (4) "Processes within landscape fragments are affected by external processes whose origin, time of arrival, and strength of impact cannot be known in advance. Nevertheless, with certainty an external process will severely negatively impact natural functioning processes within the landscape fragment." Jim Sanderson & Larry D. Harris, *Brief History of Landscape Ecology*, *in* LANDSCAPE ECOLOGY: A TOP-DOWN APPROACH 94-95 (Jim Sanderson & Larry D. Harris eds., 2000).

149. May, *supra* note 104, at 14.

150. *See* Simon A. Levin, *Ecosystems and the Biosphere as Complex Adaptive Systems*, 1 ECOSYSTEMS 431 (1998). *See generally* SCOTT CAMAZINE ET. AL., SELF-ORGANIZATION IN BIOLOGICAL SYSTEMS (2001).

1. Natural Areas are Adaptive

Evolution is continually reshaping ecological patterns and processes. Princeton ecologist Simon Levin says that the elements of a natural area adapt to the changes in their environment in an evolutionary fashion:

> Natural selection, together with other drivers of evolutionary change such as mutation, recombination, environmental factors, and simply chance events, provides the central organizing principle for understanding how the biosphere came to be, and how it continues to change. No teleological principles are at work at the level of the whole system, or even at the local level.[151]

As each organism adapts to its environment, it also modifies its environment, sometimes in minute ways and sometimes more dramatically.[152] Meanwhile, the environment is continually changing as a result of landscape processes, such as soil erosion, storm damage, or subsidence. "The result is a coupled, complex, dynamic system of organism and environment, wherein natural selection optimizes the fitness of populations amid a continually changing, biotically driven environment."[153]

The recognition of the complex scale of ecological processes has revived interest in the idea that evolution operates on the scale of the community as well as the individual.[154] An increasing number

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151. LEVIN, *supra* note 91, at 23 ("The biosphere is a complex adaptive system in which the never-ending generation of local variation creates an environment of continual exploration, selection, and replacement."). *But see* ALEXANDER F. SKUTCH, HARMONY AND CONFLICT IN THE LIVING WORLD 141 (2000) (hard to imagine a universe devoid of teleology).

152. *See* Wiens, *supra* note 110, at S99-100.

153. Thompson et al., *supra* note 18, at 20.

154. "Mutualism" is the term applied to relationships between different organisms that are beneficial to each. A classic example is the relationship between a seed-bearing tree and the birds that it relies on to distribute its seeds. CHARLES J. KREBS, ECOLOGY: THE EXPERIMENTAL ANALYSIS OF DISTRIBUTION AND ABUNDANCE 316-17 (4th ed. 1994). When two or more species live together in close association and have mutualistic relationships the relationship is called "symbiosis." A DICTIONARY OF ECOLOGY, *supra* note 147, at 396. In evolutionary biology, the increasing interest in microscopic forms of life has led to a growing interest in group selection phenomena. Many single organisms are now recognized to consist of highly integrated multispecies communities whose members may have previously led a more independent existence. As biologists have gained increased abilities to understand small organisms, they have learned that animals, including humans, have a symbiotic relationship with bacteria that live in the animal's body. "We could not digest and absorb food properly without our gut 'flora'." STEPHEN JAY GOULD, FULL HOUSE: THE SPREAD OF EXCELLENCE FROM PLATO TO DARWIN 184 (1996).

of biologists now believe that communities of organisms can evolve as a group.[155] Evolutionary pluralism, as the famous Harvard biologist Ernst Mayr calls it, accepts the fact that evolution can occur in many different ways among different species.[156] The study of the application of evolutionary group selection to complex system dynamics can lead to greater understanding of the way ecological communities function.[157]

2. Ecological Systems Can Be Self-Organizing

If an ecological system's complex mixture of adaptations is successful in preventing a "collapse" of the system it is said to be a self-organizing system[158] capable of fighting off external forces such as pollution or predation.[159] The strength of an ecological system's self-organizing capacity determines its "resilience;" i.e., its capacity to respond to the stresses and shocks imposed by predation or pollution from external sources.[160]

As complex, self-organizing systems, ecological systems can switch between different modes of behavior as environmental

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155. David Sloan Wilson, *Biological Communities as Functionally Organized Units*, 78 ECOLOGY 2018, 2020 (1997). Group selection was out of fashion in evolutionary biology during the period when it was believed that the gene served as the sole unit of selection. ERNST MAYR, TOWARD A NEW PHILOSOPHY OF BIOLOGY: OBSERVATIONS OF AN EVOLUTIONIST 118-19 (1988). However, subsequent research has cast doubt on the reductionist premise that genic selection is the only way in which evolution operates. *See* David Sloan Wilson, *The Group Selection Controversy: History and Current Status*, 14 ANN. L. REV. OF ECOLOGY & SYSTEMATICS 159 (1983). Although selection at the genic level is still recognized as being of major importance, there has been a resurgence of interest in group selection. *See* V.C. WYNNE-EDWARDS, EVOLUTION THROUGH GROUP SELECTION 320-26 (1986) (discussing mutualistic relationships that are hard to account for except by group selection); SKUTCH, *supra* note 151, at 147 (group selection may promote the genetic diversity that insures against failure to adapt to a changing environment).

156. ERNST MAYR, ONE LONG ARGUMENT: CHARLES DARWIN AND THE GENESIS OF MODERN EVOLUTIONARY THOUGHT 149, 157 (1991) ("Some species are, while others are not, subject to group selection.").

157. Wilson, *supra* note 155, at 2023.

> When natural selection operates at the community level, all of the species in a local community become part of a single interacting system that produces a common phenotype, more like genes than species as we usually think of them, and the local community acquires the properties of adaptation that we usually associate with individuals.

Id. at 2024. Some game theorists now believe that cooperation among members of a group may be an evolutionary successful adaptation even in the absence of reciprocity. *See* Rick L. Riolo et al., *Evolution of Cooperation Without Reciprocity*, 414 NATURE 441 (2001).

158. Norton, *supra* note 133, at 64. *See also* Ruhl, *supra* note 126, at 947.

159. EDWARD B. BARBIER ET AL., PARADISE LOST? THE ECOLOGICAL ECONOMICS OF BIODIVERSITY 25-27 (1994) ("Hierarchy theory views ecological systems as complex, multi-layered systems that are self-organizing . . . .").

160. *Id.* at 25-27. *See also* Steve Carpenter et al., *From Metaphor to Measurement: Resilience of What to What?*, 4 ECOSYSTEMS 765 (2001).

conditions change. Self-organization allows systems to change as a result of the characteristics of the constituent species, not solely by waiting for the results of evolutionary selection. For example, a tropical savanna is continually being exposed to droughts, floods, differences in soil nutrients, and an intermittent fire regime. These fluctuations change the local species composition and abundance, but to an ecologist the system is merely "exploring" all of the states that the system can assume and still be considered a tropical savanna.[161]

Hierarchy theory views ecological systems as complex, multi-layered systems that communicate both upward and downward across all levels of nature with a "creative force, which we now know depends upon a mix of stable, predictable elements and chaotic, unpredictable ones."[162] All ecological systems are subject to destabilizing influences, such as invasive species, climate variation and erosion, that help maintain diversity and resilience in ecological systems, but self-organizing characteristics are important in maintaining productivity and in facilitating recovery from disturbance.[163]

The use by ecologists of the term "self-organizing" does not imply that ecological systems are superorganisms that operate in some teleological fashion, as once was believed.[164] It means that if a natural area is left alone, the normal processes of evolutionary adaptation will cause the system to organize itself, although it will do so in a way that is predictable only in general terms.[165] Research into self-organization is focusing on processes such as energy cascading, material cycling and information organizing. Chaos and complexity theories offer intriguing possibilities but remain to be fully fleshed out.[166]

C. Ecological Processes Are as Important as Ecological Patterns

Ecology originated as an attempt to classify and study the relation of various organisms to landscape patterns, focusing on apparently discrete entities such as bogs, dunes, or prairies.[167]

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161. Solbrig, *supra* note 80, at 109-10.

162. Norton, *supra* note 133, at 64.

163. C. S. Holling, *Engineering Resilience versus Ecological Resilience*, *in* ENGINEERING WITHIN ECOLOGICAL CONSTRAINTS 31, 32 (Peter C. Schulze ed., 1996).

164. *See generally* Norton, *supra* note 133.

165. For an interesting account of the attempt to use complexity theory to bring order to ecological systems (among other complex adaptive systems), see PER BAK, HOW NATURE WORKS: THE SCIENCE OF SELF-ORGANIZED CRITICALITY 121-27 (1996).

166. Henry A. Regier, *The Notion of Natural and Cultural Integrity*, *in* ECOLOGICAL INTEGRITY AND THE MANAGEMENT OF ECOSYSTEMS 3, 5 (Stephen Woodley et al. eds., 1993)

167. DONALD WORSTER, NATURE'S ECONOMY: A HISTORY OF ECOLOGICAL IDEAS 192-94 (2d

Early biogeographers, who created maps showing the distribution of communities of animals and plants, played an important role in increasing the awareness of differences among ecological patterns.[168] Some ecologists have now opined that although landscape patterns "look pretty interesting," they have little intrinsic significance except in the context of ecological processes.[169] This view is perhaps extreme, and the study of patterns remains an important part of ecology,[170] but most contemporary ecologists do at least tend to emphasize process as well as pattern.[171]

What is an ecological process? Like ecosystems, processes can be defined by aggregation and subdivision in various ways. A basic division usually starts by separating landscape level processes from processes internal to the ecological system:

1. Landscape Level Processes

Landscape ecologist Larry Harris and his colleagues identify four categories of landscape-level ecological processes: (1) external forces unrelated to biological processes, such as hurricanes, glaciers, or floods; (2) physical forces dependent on biota for propagation, such as wildfire; (3) biological landscape processes, such as the changes in the landscape created by beavers building dams or elephants trampling vegetation; and (4) human impacts on the landscape, such as habitat modification and pollution.[172]

Large scale ecology, in combination with expertise from other scientific disciplines, has greatly improved our understanding of

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ed. 1994).

168. *See, e.g.*, ROSCOE POUND & FREDERIC E. CLEMENTS, THE PHYTOGEOGRAPHY OF NEBRASKA (1900). The field of biogeography continues to specialize in the spatial aspects of the distribution of organisms. *See generally* ANALYTICAL BIOGEOGRAPHY: AN INTEGRATED APPROACH TO THE STUDY OF ANIMAL AND PLANT DISTRIBUTIONS (A.A. Myers & P.S. Giller eds., 1988).

169. Roy Haines-Young, *Landscape Pattern: Context and Process*, *in* ISSUES IN LANDSCAPE ECOLOGY 33 (John A. Wiens & Michael R. Moss eds., 1999).

170. Dale et al., *supra* note 47, at 651-53.

171. Sanderson & Harris, *supra* note 148, at 16. The goal should be "the restoration of natural ecological processes across the landscape rather than the maintenance of certain landscape patterns." For a discussion of ethical issues in ecological restoration, see Alyson C. Flournoy, *Restoration Rx: An Evaluation and Prescription*, 42 ARIZ. L. REV. 187 (2000); C. Mark Cowell, *Ecological Restoration and Environmental Ethics*, 15 ENVTL. ETHICS 19 (1993).

172. Larry D. Harris et al., *Landscape Processes and Their Significance to Biodiversity Conservation*, *in* POPULATION DYNAMICS IN ECOLOGICAL SPACE AND TIME 319, 328-37 (Olin E. Rhodes, Jr. et al. eds., 1996). *See also* Norman L. Christensen, Jr., *Managing for Heterogeneity and Complexity on Dynamic Landscapes*, *in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 167, 178 (S.T.A. Pickett et al. eds., 1997) (ecological patterns are often greatly affected by "chance" events like weather variation).

these processes.[173] Hurricanes, for example, can be observed on a worldwide scale, and the history of the ecological effects of these storms can be tracked in broad terms on the scale of centuries,[174] and in more detail on the scale of years.[175] Our understanding of the history and geography of wildfire ecology has improved greatly and has begun to influence national policy.[176]

And of prime importance, we have become better able to analyze the impacts of our own influence on nature; when we step back and look at the big picture both geographically and historically, we can observe patterns of impact that would not be apparent otherwise.[177] For example, large scale comparison of the sites of the remaining populations of the endangered California red-legged frog with sites formerly occupied by the frog showed a strong positive association of the abandoned sites with nearby agricultural activity, suggesting that pesticide application may be contributing to the frog's extinction.[178] And numerous studies of changing habitats over large time and space scales have revealed the impact of climate change on a wide range of plants and animals.[179]

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173. For example, a biochemical analysis of Hawaiian forest soils demonstrated that many of the nutrients in the soils came from dust that had been transported by wind from Central Asia, over 6000 kilometers away, during dry periods in geologic history. O.A. Chadwick et al., *Changing Sources of Nutrients During Four Million Years of Ecosystem Development*, 397 NATURE 491 (1999).

174. Emery R. Boose et al., *Landscape and Regional Impacts of Hurricanes in New England*, 71 ECOLOGICAL MONOGRAPHS 27 (2001).

175. Hans W. Paerl et al., *Ecosystem Impacts of Three Sequential Hurricanes (Dennis, Floyd, and Irene) on the United States' Largest Lagoonal Estuary, Pimlico Sound, NC*, 98 PROC. NAT'L ACAD. SCI. USA 5655 (2001).

176. *See infra* text accompanying notes 667-699.

177. "The appropriate domains of causality in many ecological studies could extend far beyond previously assumed spatial and temporal bounds." Thompson et al., *supra* note 18, at 21. Thompson and his co-authors also suggest the need for research to determine whether landscape-level processes create biophysical constraints on a site that produce what complexity theorists would call an "evolutionary attractor" that establishes a model of organism function that evolution would try to achieve. *Id*. *See also* ROBERT WESSON, BEYOND NATURAL SELECTION 144-50 (1991) (the genome is a series of linked attractors at all levels of genetic stability).

178. Carlos Davidson et al., *Declines of the California Red-legged Frog: Climate, UV-B, Habitat, and Pesticides Hypotheses*, 11 ECOLOGICAL APPLICATIONS 464, 474-75 (2001). The study also found that many of the formerly occupied sites were at higher elevations than those still occupied; there has been a worldwide decline in amphibian populations, particularly at high elevations, for reasons that biologists do not yet understand. *Id*. at 473-474. The authors of the study do not claim that they have identified the exact cause of the decline in the frog population, but the study appears to make it unlikely that the decline is solely the result of competition with non-native bullfrogs. *Id*. at 475-76.

179. *See infra* text accompanying notes 468-79.

2. Internal Ecological Processes

Internal ecological processes include those processes resulting from the interaction of the organisms in an area. Thomas Parker and Steward Pickett divide these into five categories:

> (1) the movements and interactions of individual organisms;
>
> (2) the transformation of energy and materials;
>
> (3) the successional replacement of one set of species by another;
>
> (4) the changes in size and composition of particular patches of habitat, and
>
> (5) the responses of the area to regional or global scale environmental change.[180]

The first three of these processes have been traditional subjects of ecological study. Haeckel, the founder of the term ecology, defined it as the study of the interaction of organisms and their environment.[181] Lindeman's pioneering study,[182] followed by Odum's extensive work, looked at the flow of energy through natural systems.[183] Early ecologists like Clements and Cowles focused on the succession of plants and animals in changing landscapes.[184]

The fourth and fifth of these categories have been of particular interest in recent years. The ability to view landscapes from larger spatial and temporal scales has shown us a kaleidoscopic pattern of landscape patches that come and go over time. The study of these movements is known as the study of "patch dynamics," and it has significantly affected ecologists' ideas about the natural world.[185] And the impact of climate change on ecological patterns has recently become one of the most challenging issues of our time.[186]

The internal ecological processes of an area must operate within the ranges set by the landscape level processes. Thus, for example, the biological productivity of an area is limited by soil conditions,

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180. Parker & Pickett, *supra* note 115, at 17, 22.
181. ANNA BRAMWELL, ECOLOGY IN THE 20TH CENTURY: A HISTORY 40 (1989).
182. WORSTER, *supra* note 167, at 306-09.
183. ODUM, *supra* note 133, at 32-35.
184. PETER J. BOWLER, THE NORTON HISTORY OF THE ENVIRONMENTAL SCIENCES, 373-76 (1993).
185. *See infra* text accompanying notes 225-35.
186. *See infra* text accompanying notes 457-91.

water availability, and climate,[187] and while "chronic human intervention may broaden these ranges," it "cannot entirely evade the constraints of place."[188]

Many ecological processes confer enormous benefits on the human race, such as purification of air and water, pest control, flood abatement, pollination, climate regulation, and soil nutrient cycling; this has led to a movement toward trying to quantify the benefits of "ecosystem services" in an effort to increase public comprehension of the importance of these processes.[189] Contemporary ecology increasingly recognizes that landscape-level processes, including both the natural changes in the landscape resulting from fire and storms and the changes resulting from human activities, must be studied along with changes internal to the ecological systems themselves if ecological processes are to be correctly understood.[190] Analysis of the interaction of the landscape level and internal processes requires consideration of a wide range of scales,[191] from centimeters to hundreds of kilometers.[192]

A focus on the protection of ecological processes is seen by some ecologists as a way to avoid getting bogged down in the details of hundreds or thousands of individual species, thereby losing sight of the forest for the trees.[193] Conservation biologists, who work out in

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187. John J. Ewel, *Ecosystem Processes and the New Conservation Theory*, *in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 252, 259 (Steward Pickett et al. eds, 1997) ("To sustain biological richness, the abiotic features of the ecosystem must be retained, and in the case of terrestrial ecosystems the most vulnerable abiotic factor is soil fertility.").

188. Dale et al., *supra* note 47, at 651-52 ("For instance, enhanced productivity on desert uplands can be supported over the short term by additions of water; however, higher productivity generally cannot be sustained in arid-land soils over the long run because of the degrading effects of high evapotranspiration rates and resulting salinization."). *See also* Ken Lertzman & Joseph Fall, *From Forest Stands to Landscapes: Spatial Scales and the Roles of Disturbances*, *in* ECOLOGICAL SCALE: THEORY AND APPLICATIONS 339, 349 (David L. Peterson & V. Thomas Parker eds., 1998) ("The effects of local conditions of soil and microclimate on vegetation are ubiquitous.").

189. *See, e.g.*, Robert L. Fischman, *The EPA's NEPA Duties and Ecosystem Services*, 20 STAN. ENVTL. L.J. 497 (2001).

190. Monica G. Turner, *Ecological Dynamics at Broad Scales: Ecosystems and Landscapes*, *in* SCIENCE AND BIODIVERSITY POLICY S-29, S-34 (BioScience Supplement, 1995).

191. Paul G. Risser, *Landscape Ecology: The State of the Art*, *in* LANDSCAPE HETEROGENEITY AND DISTURBANCE 3, 12 (Monica Goigel Turner ed., 1987).

192. Plant growth, for example, is determined by vegetative processes that operate at scales of centimetres to tens of metres and days to decades. At the other extreme, slow geomorphological processes define basic topography and soil composition at very large scales. "In between, contagious disturbance processes such as fire, insect outbreak, plant disease, and water flow form patterns over spatial scales of tens of metres to hundreds of kilometres." Holling, *supra* note 139, at 484.

193. Daniel Simberloff, *Flagships, Umbrellas, and Keystones: Is Single-Species Management Passé in the Landscape Era?*, 83 BIOLOGICAL CONSERVATION 247, 252 (1998) ("The emphasis on processes automatically leads to a broad spatial scale with a focus on landscapes . . . . Thus, ecosystem management, though not simply the management version of landscape

the real world to try to apply principles of ecology to particular problems, sometimes worry that too much focus on process might be used as an excuse to downplay the importance of individual rare species and the protection they get from the Endangered Species Act,[194] but no one denies that improved understanding of ecological processes is desirable.

III. LEARNING FROM LARGE-SCALE PROCESSES

The large-scale ecologists' study of ecological processes at a wide range of scales has led to significant advances in ecological theory. By expanding the size of the area and the length of time covered by ecological studies, ecologists have cast new light on some propositions that had been widely accepted and have developed new theories that better explain ecological phenomena. Some of the most visible and apparently drastic changes in the environment appear cyclical when viewed from a larger scale. But on the other hand, many of the cumulative effects of small scale changes that all go in the same direction have grave implications that ecologists cannot forecast because they are outside the parameters of historical experience.

A. Competition Doesn't Always Cause Extinction

"Competitive exclusion," the idea that all continued competition between different species would eventually end with the extinction of the weaker competitor, was a mainstay of biological theory for over a century.[195] Ever since Darwin's time, scientists have studied the role of competition among species, and many have tended to assume that over time the better competitor would eliminate the weaker competitor.[196]

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ecology, is very closely related to the latter discipline.").

194. REED F. NOSS & ALLEN Y. COOPERRIDER, SAVING NATURE'S LEGACY: PROTECTING AND RESTORING BIODIVERSITY 90-91 (1994). For expressions of concern that "process" may be given too much emphasis today, see Simberloff, *supra* note 193, at 251-54; Oliver A. Houck, *On the Law of Biodiversity and Ecosystem Management*, 81 MINN. L. REV. 869, 974-75 (1997).

195. The idea that competitive exclusion was a universal phenomena that could be predicted mathematically dates back to the 1930s. A DICTIONARY OF ECOLOGY, *supra* note 147, at 93-94. For an overall analysis of past and current ideas about competitive exclusion, see TOKESHI, *supra* note 53, at 215-48.

196. *See, e.g.*, GEORGE GAYLORD SIMPSON, THE MEANING OF EVOLUTION 221-24 (1949). The term "survival of the fittest" was coined by Herbert Spencer, later adopted by Darwin, and frequently used in ways unintended by either Spencer or Darwin. PETER J. BOWLER, EVOLUTION: THE HISTORY OF AN IDEA 240-42, 342-43 (rev. ed. 1989). *See also* ERNST MAYR, EVOLUTION AND THE DIVERSITY OF LIFE 74-75 (1976) (Darwin used fitness in the sense of being well adapted to the environment).

1. Nature's Puzzling Variety

Despite the wide acceptance of the competitive exclusion theory, the theory rarely seemed to play out in practice.[197] Ecologists have long been puzzled why so many species continue to exist in the face of competition.[198] The apparent inconsistency between theory and observation has encouraged extensive empirical analysis of other processes that might be forestalling competitive exclusion.[199] Modern studies of natural areas have continued to find many more coexisting species (i.e., greater "species richness") than the theory of competitive exclusion would have predicted.[200] "Even highly competitive assemblages such as freshwater fish and songbirds are unsaturated, suggesting that interspecific competition is not sufficient to produce a ceiling on local richness."[201]

Today, with the longer time and larger space horizons of large scale ecology, it is apparent that the theory of competitive exclusion can operate only under hypothetical conditions of environmental stability that are seldom found in nature. The primary failing of the theory was its inherent assumption that ecological systems were often in an equilibrium state.

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197. HUBBELL, *supra* note 39, at 10-11 ("[t]he number of cases in which local extinction can be definitively attributed to competitive exclusion is vanishingly small.").

198. The classic paper calling attention to the issue was G.E. Hutchinson, *Homage to Santa Rosalia, or Why Are There So Many Kinds of Animals?* 93 AMERICAN NATURALIST 145 (1959). *See also* CHARLES ELTON, ANIMAL ECOLOGY 27 (1927) ("[s]uccession . . . does not take place with the beautiful simplicity which we could desire . . . ."); STEPHEN J. GOULD, WONDERFUL LIFE: THE BURGESS SHALE AND THE NATURE OF HISTORY 236-39 (1989) (stating that no evidence shows that extinct creatures fossilized in Burgess Shale were less successful at adaptation than those that survived).

199. James H. Brown, *Two Decades of Homage to Santa Rosalia: Toward a General Theory of Diversity*, 21 AMERICAN ZOOLOGIST 877, 886 (1981) (Stating that ecologists should search for patterns that affect the fitness of species to the environment). Lack of success in competition is often a product of factors other than the process of competition itself. Certain demographic processes, such as the loss of genetic variability, may result in a feedback mechanism that can increase death rates or decrease birth rates. BROWN, *supra* note 52, at 159.

200. *See, e.g.*, Clarence L. Lehman & David Tilman, *Competition in Spatial Habitats*, *in* SPATIAL ECOLOGY: THE ROLE OF SPACE IN POPULATION DYNAMICS AND INTERSPECIFIC INTERACTIONS 185, 191 (David Tilman & Peter Kareiva eds., 1997) (pointing out that in reality, environmental heterogeneity limits the operation of competitive exclusion); Cornell & Karlson, *supra* note 127, at 262-67 (concluding that studies of coral reefs show that various forms of heterogeneity in space and time can forestall competitive exclusion indefinitely).

201. Cornell & Karlson, *supra* note 127, at 250, 267. *See also* S. Joseph Wright, *Plant Diversity in Tropical Forests: A Review of Mechanisms of Species Coexistence*, 130 OECOLOGIA 1, 2 (2002) (discussing various ways in which plants in tropical forests avoid competitive exclusion).

2. Environmental Change May Promote Biological Diversity

A better understanding of the rise and fall of the populations of individual species has come about because of the growing interest of ecologists in expanding the geographic scale of their studies, so that the studies include heterogeneous areas with varied habitats.[202] For example, ecologists now believe that the theory of competitive exclusion failed to take into consideration the extent to which competition is disrupted by environmental variation and change over large areas.[203] Today, ecologists recognize that evolution does not operate in a vacuum.[204] Evolution selects optimal phenotypes only in an environment that varies with regularity. "In an unpredictably variable environment, phenotypes will be selected that can survive the various unpredictable environmental circumstances."[205] As in economic markets, in biological evolution diversity emerges naturally from competition as different species develop varying strategies to adapt to unpredictable environmental change.[206]

In addition, by extending the temporal scale of ecological studies, ecologists can observe population patterns over extended time periods, which enables them to more accurately analyze the effects of environmental change.[207] The availability of longer time series of data has made it apparent that evolution, in response to environmental change, may take place quite rapidly.[208] Jonathan Weiner, in his Pulitzer prize-winning book, *The Beak of the Finch* (1995), called attention to the work of ecologists Peter and Rosemary Grant, whose analysis of the effects of changing environmental conditions on the populations of various species on

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202. *See, e.g.*, Ilkka Hanski, *Effects of Landscape Pattern on Competitive Interactions, in* MOSAIC LANDSCAPES AND ECOLOGICAL PROCESSES 203 (Lennart Hansson et al. eds., 1995).

203. *See, e.g.*, Matt J. Keeling et al., *Reinterpreting Space, Time Lags, and Functional Responses in Ecological Models*, 290 SCI. 1758 (2000).

204. Peter Chesson & Nancy Huntly, *The Roles of Harsh and Fluctuating Conditions in the Dynamics of Ecological Communities*, 150 AM. NATURALIST 519, 521 (1997) ("Environmental fluctuations provide opportunities for temporal niche partitioning but do not fundamentally change the impact of interspecific competition."). The early studies are reviewed in Julie Sloan Denslow, *Disturbance-Mediated Coexistence of Species, in* THE ECOLOGY OF NATURAL DISTURBANCE AND PATCH DYNAMICS 307 (S.T.A. Pickett & P.S. White eds.1985).

205. Solbrig, *supra* note 80, at 107. *See* S.T.A. PICKETT & P.S. WHITE, *Patch Dynamics: A Synthesis, in* THE ECOLOGY OF NATURAL DISTURBANCE AND PATCH DYNAMICS 371, 373 (S.T.A. Pickett & P.S. White eds., 1985) ("The most obvious role that disturbance plays in ecosystems is in the deflection of a community from some otherwise predictable successional path.").

206. LEVIN, *supra* note 91, at 133.

207. *See, e.g.*, Jason E. Tanner et al., *Species Coexistence, Keystone Species, and Succession: A Sensitivity Analysis*, 75 ECOLOGY 2204 (1994).

208. Thompson, *supra* note 65.

the Galapagos Islands documented rapid evolution in response to environmental change.[209]

Some dominant species may recede to a lesser status if they lack the ability to cope with environmental change, particularly if it is a steady change in the same direction ("unidirectional change"). Such changes have been particularly noticeable in the northern latitudes, where the warming of the climate has been steady and severe.[210] For example, a common bird in the Swedish forests, the collared flycatcher, is experiencing reduced body weight in nestlings.[211] The evolutionary trend toward increased body weight has now apparently been counteracted by a decline in the abundance of the caterpillars on which the birds feed while nesting.[212] The decline appears to be the result of the fact that trees are budding earlier in the warming temperatures, and the caterpillars no longer emerge at the ideal time for the birds' nourishment.[213]

On the other hand, those species that invest heavily in the functions that enable them to weather environmental variability may make trade-offs that weaken their ability to compete in other ways.[214] For instance, "some plant species allocate a high proportion of their mass to their roots," which makes them better able to adjust to fluctuations in soil nutrients. But, by doing so, they "have less [energy] to allocate to other structures, such as leaves, stems, [and] seeds," and thus, may have inferior abilities to

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209. *See also* Peter R. Grant et al., *Effects of El Niño Events on Darwin's Finch Productivity*, 81 ECOLOGY 2442 (2000); Peter R. Grant and B. Rosemary Grant, *Unpredictable Evolution in a 30-Year Study of Darwin's Finches*, 296 SCI. 707 (2002)..

210. ROGER G. BARRY & RICHARD J. CHORLEY, ATMOSPHERE, WEATHER & CLIMATE 351-52 (7th ed. 1998).

211. J. Merila et al., *Cryptic Evolution in a Wild Bird Population*, 412 NATURE 76 (2001).

212. *Id.* at 78. For commentary on this study, see David J. Hosken, *Hidden Change: Cryptic Evolution in Flycatchers*, 16 TRENDS IN ECOLOGY & EVOLUTION 593 (2001).

213. Marcel E. Visser & Leonard J.M. Holleman, *Warmer Springs Disrupt the Synchrony of Oak and Winter Moth Phenology*, 268 PROCEEDINGS OF THE ROYAL SOC'Y OF LONDON 289 (2001). *See also* R. B. Mynemi et al., *Increased Plant Growth in Northern High Latitudes from 1981 to 1991*, 386 NATURE 698 (1997); William E. Bradshaw & Christina M. Holzapfel, *Genetic Shift in Photoperiodic Response Correlated with Global Warming*, 98 PROC. NAT'L ACAD. SCI. U.S. 14508 (2001). Scientists are concerned about the ability of animal species to evolve rapidly enough to adapt to the pace of climate change. "Global warming will occur so quickly that changes in the ecosystem may lag significantly behind (several hundred years behind the climate changes)." FRANCES DRAKE: GLOBAL WARMING: THE SCIENCE OF CLIMATE CHANGE 209 (2000). Comparable climate changes have occurred in the past, but not in so short a time. Harold A. Mooney et al., *Biodiversity and Ecosystem Functioning: Basic Principles, in* GLOBAL BIODIVERSITY ASSESSMENT 275, 321 (Vernon H. Heywood ed., 1995).

214. LEVIN, *supra* note 91, at 133 ("Biodiversity feeds on itself in the sense that it is the changing adaptive landscape . . . that makes alternative lifestyles attractive and enhances diversity.").

compete by acquiring light or dispersing seed.[215] Thus, they may appear to be inadequate competitors under any particular set of conditions at a given time or place, but at larger scales, their superior adaptability can be seen.[216]

One result of the more realistic attitude toward competition is a revised attitude toward so-called "exotic species."[217] Concern about the introduction of new species to an area remains high, given the tragic experience that has followed from some past introductions.[218] But, the fatalistic assumption that successful invaders would always drive native species to extinction through competition no longer seems plausible.[219] It is being replaced by case-by-case analysis of particular species relationships.[220]

When some of the earlier postulates of ecology, such as competitive exclusion, failed to hold up under empirical testing, ecologists began to reexamine some of the basic premises of their research.[221] One of the most significant results of that reexamination has been the recognition that too many early ecological theories were based on assumptions of environmental stability that were unscientific in origin.[222] This led ecologists to put new emphasis on the processes of environmental change.

B. Fragmentation Doesn't Always Reduce Diversity

Most European settlers in America probably shared what has been called the Tory view of landscape–a romantic attachment to the ideas of continuity and tradition felt to be embodied in the

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215. David Tilman, *Community Diversity and Succession: The Roles of Competition, Dispersal, and Habitat Modification*, *in* BIODIVERSITY AND ECOSYSTEM FUNCTION 327, 329 (Ernst-Detlev Schulze & H.A. Mooney, eds. 1994).

216. *See* Ove Eriksson, *Functional Roles of Remnant Plant Populations in Communities and Ecosystems*, 9 GLOBAL ECOLOGY & BIOGEOGRAPHY 442 (2000).

217. *See, e.g.*, Dov F. Sax & James H. Brown, *The Paradox of Invasion*, 9 GLOBAL ECOLOGY & BIOGEOGRAPHY 363 (2000) (invaders succeed because evolution of native species was limited by the lack of available genetic resources); Michael L. Rosenzweig, *The Four Questions: What Does the Introduction of Exotic Species do to Diversity?*, 3 EVOLUTIONARY ECOLOGY RES. 122 (2001).

218. The classic text is MARK WILLIAMSON, BIOLOGICAL INVASIONS (1996).

219. "We routinely overlook the flexibility, opportunism, and facultative use of resources of which variable individuals in species are universally capable – not to mention potential evolutionary responses. I believe that most species will be found to be far less specialized in resource use than current theory suggests." HUBBELL, *supra* note 39, at 328.

220. *See, e.g.*, NANAKO SHIGESADA & KOHKICHI KAWASAKI, BIOLOGICAL INVASIONS: THEORY AND PRACTICE 109-14 (1997). *See* BROWN, *supra* note 52, at 217-24.

221. HUBBELL, *supra* note 39.

222. The 'balance of nature' was "a concept rooted in Christian and Enlightenment world views." Lakshman Guruswamy, *Integration & Biocomplexity*, 27 ECOLOGY L.Q. 1191, 1204 (2001).

classical European landscapes.[223] Today's ecologists have a much different view of landscape, seeing it more like a kaleidoscope of heterogeneous patches that shift into new configurations frequently.[224] This ecological insight has called into question many popular ideas about the natural world.

1. Patch Dynamics

In large-scale ecology, the natural world is viewed from a distance, both in space and in time. From that perspective, boundaries of ecosystems appear and disappear in a ballet of "patch dynamics,"[225] through which the characteristics of natural areas change as the plants and animals adjust to changing environmental conditions.[226]

The theory of patch dynamics begins by viewing the natural world as a mosaic of individual patches of habitat, rather than as large blocks of space having generally similar characteristics.[227] The dynamics occur as patches of habitat move over time as a result of landscape level processes; the various species in the habitat move in response, and these internal ecological processes further modify the habitat in an unending process that may be very slow or quite rapid.[228] This dynamic ecological theory recognizes that nature is continually changing[229] and that we must evaluate the effects of our activities against this moving target.[230]

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223. NIGEL EVERETT, THE TORY VIEW OF LANDSCAPE 1 (1994). For a cogent analysis of the history of attitudes toward conservation, see JOHN PASSMORE, MAN'S RESPONSIBILITY FOR NATURE 73-100 (1974).

224. The idea that certain landscapes were a "dynamic mosaic of . . . patches" can be traced back to the 1930s. H.H. Shugart, *Equilibrium Versus Non-Equilibrium Landscapes*, *in* ISSUES IN LANDSCAPE ECOLOGY 18, 19 (John A. Wiens & Michael R. Moss eds., 1999). Western hemisphere ecologists typically use the term "patch" to refer to a piece of relatively similar habitat, while some European ecologists prefer the term "ecotope." FARINA, *supra* note 110, at 50-52.

225. *See generally* LIVING IN A PATCHY ENVIRONMENT (Bryan Shorrocks & Ian R. Swingland eds., 1990).

226. Judy L. Meyer, *The Dance of Nature: New Concepts in Ecology*, 69 CHI.-KENT L. REV. 875, 881 (1994).

227. COMM. ON SCIENTIFIC ISSUES IN THE ENDANGERED SPECIES ACT, NAT'L RESEARCH COUNCIL, SCIENCE AND THE ENDANGERED SPECIES ACT 95-97(1995). The EPA sees the pattern and connectivity of habitat patches as an important element of environmental impact analysis. OFFICE OF FEDERAL ACTIVITIES, U.S. EPA, CONSIDERING ECOLOGICAL PROCESSES IN ENVIRONMENTAL IMPACT ASSESSMENTS 17-22 (1999).

228. *See* Wiens, *supra* note 110.

229. Some environmental cycles of change are very familiar, such as the differences in temperature between night and day or between summer and winter. Environmental change is often so short-range that plants and animals "average over them" or shut down and gear back up later, as with diurnal and annual cycles of night and day, warmth and cold, or even longer range cycles of drought and flood. LEVIN, *supra* note 91, at 74.

230. DANIEL B. BOTKIN, DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE TWENTY-FIRST

Patch dynamics is increasingly used as an unifying concept in large scale ecology.[231] For example, a species that appears to be out-competing its rivals at one point in time may appear to be the weaker competitor at a later time when environmental conditions have changed through patch dynamics.[232] Viewed from a hierarchical perspective, in which individual patches of habitat are analyzed from different scales, the process of environmental change can be seen as a valuable attribute of nature rather than an "imbalance" to be corrected.[233]

Because some of the changes in patch dynamics are caused by human intervention, the study of patch dynamics inevitably must look at the ecology of human-created as well as natural patches.[234] Patch dynamics recognizes that humans are part of nature and that the human influence on the environment can often be condemned but rarely ignored.[235]

Where an area is characterized by a wide range of differing patches of habitat, it is referred to as "heterogeneous."[236] In many cases, animals rely heavily on two or more habitats at different seasons, and the proximity of these different habitats creates reciprocal subsidies for the species that inhabit them.[237] For example, a study of the interaction of a forest and a stream in Japan found that aquatic insects emerging in the Spring from the stream provided 25.6% of the annual energy supply of forest birds, while during the summer the terrestrial invertebrates that washed

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CENTURY 190 (1990).

231. Wu & Loucks, *supra* note 129, at 449.

232. Judy L. Meyer, *Conserving Ecosystem Function*, *in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 136, 140 (Steward Pickett et al. eds., 1997) (Species may respond differently in the functions they perform as the environment changes).

233. Wu & Loucks, *supra* note 129, at 447 ("Recognition of the scale-dependence and hierarchical structure of patchiness is crucial to understanding the dynamics and stability of ecological systems.").

234. A. Dan Tarlock, *Environmental Law, But Not Environmental Protection*, *in* NATURAL RESOURCES POLICY AND LAW: TRENDS AND DIRECTIONS 178, 188-89 (Lawrence J. MacDonnell & Sarah F. Bates eds., 1993) (conservation biology recognizes interaction of humans and nature).

235. Peter M. Vitousek, *Beyond Global Warming: Ecology and Global Change*, 73 ECOLOGY 1861, 1873 (1994) ("The world has changed as a consequence of human action and will change more; we need to recognize, anticipate, and work with change at the same time as we work to minimize many of its consequences."). FIKRET BERKES, SACRED ECOLOGY: TRADITIONAL ECOLOGICAL KNOWLEDGE AND RESOURCE MANAGEMENT 164 (1999). ("Although much of ecology continues as a conventional reductionistic science, the more holistic approaches in ecology provide a new vision of the earth as an ecosystem of interconnected relationships in which humans are part of the web of life.").

236. RICHARD T.T. FORMAN & MICHAEL GODRON, LANDSCAPE ECOLOGY 473 (1986) (The concept of an ecological "niche" must include "the combination of uses found in a heterogeneous assemblage of ecosystems in a landscape.").

237. Forman, *supra* note 141, at 219-20.

into the stream from the forest constituted 44% of the energy supply of fish in the stream.[238]

Some studies have found a powerful link between habitat heterogeneity and species richness.[239] The fact that habitats are both spatially and temporally heterogeneous[240] has been called "one of the fundamental concepts of modern ecology."[241] Although heterogeneity can be valuable in some cases,[242] in other cases it can work against the cause of conservation.[243] For example, in some island environments extensive heterogeneity has been created by human activities and the introduction of non-native species and diseases; this has driven many native species to or near extinction, as has happened in Hawaii.[244] But in other contexts, heterogeneity may effectively preserve biodiversity by protecting a balance in prey-predator relationships by providing a variety of habitats in which differing predator success rates can be expected.[245]

Ecologists who study microbes point out that we humans are ourselves heterogeneous habitats. As biological technology increasingly allows more effective study of microorganisms, we have become aware of the variety and complex relationships of the microscopic species within our own bodies. Like other animals, we

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238. Shigeru Nakano & Masashi Murakami, *Reciprocal Subsidies: Dynamic Interdependence Between Terrestrial and Aquatic Food Webs*, 98 PROC. OF THE NAT'L ACAD. OF SCI., U.S.A. 166 (2001).

239. A recent study of Canadian butterflies shows that the diversity of butterfly species is closely related to the heterogeneity of the environment. Jeremy T. Kerr, *Butterfly Species Richness Patterns in Canada: Energy, Heterogeneity, and the Potential Consequences of Climate Change*, 5 CONSERVATION ECOLOGY (1) 10 (2001), *available at* http://www.consecol.org/vol5/iss1/art10 (last visited Sept. 14, 2001).

240. On the history and meaning of the term, see Robert P. McIntosh, *Concept and Terminology of Homogeneity and Heterogeneity in Ecology*, *in* ECOLOGICAL HETEROGENEITY 24 (Jurek Kolasa & S.T.A. Pickett eds., 1991).

241. NAT'L RESEARCH COUNCIL, *supra* note 227, at 95.

242. S.T.A. Pickett & M.L. Cadenasso, *Landscape Ecology: Spatial Heterogeneity in Ecological Systems*, 269 SCI. 331, 334 (1995).

243. For example, the damage caused by white-tailed deer has increased because of their ability to avoid their predators in small patches of woodland scattered among other habitats. Risser, *supra* note 82, at 8.

244. John J. Ewel, *Ecosystem Processes and the New Conservation Theory*, *in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 252, 258 (Steward Pickett et al. eds, 1997).

245. In homogenous settings, such associations are liable to extinction via ever-diverging cycles of boom and bust of prey populations, interacting with similar but lagged cycles for the predators. But in a heterogeneous, patchy world, the associations can persist as a shifting mosaic of empty patches, prey only patches where prey populations are doing well, and patches with prey and predator where predators are currently flourishing.

May, *supra* note 104, at 7. *See also* Mooney et al., *supra* note 213, at 313 (patch dynamics is an important source of biodiversity).

harbor a heterogeneous mix of living creatures, some of which are essential to our survival while others can be harmful.[246]

Regardless of whether heterogeneity is desirable or not, ecologists tend to view it as an inevitable product of ecological processes – one that needs to be studied rather than avoided.[247] Many biologists have observed a long-range trend toward greater complexity in organisms and greater heterogeneity in their interrelationships.[248] The same processes that create nonequilibrium time dynamics may also create heterogeneous physical structure.[249] It seems likely that the more that ecological systems change over time, the more these changes will result in complex mosaics of habitat in various stages of change.[250]

2. Metapopulation Ecology

Ecologists generally support the idea that we should be protecting natural areas on a large scale,[251] but when priorities must be set, which types of habitat deserve the most protection? Even if our goal is primarily the protection of individual species, the fact that a species may be found in a particular habitat does not necessarily tell us whether and to what extent that habitat is important to that species.[252]

Ecologists refer to the aggregate of individual populations of a species that are occupying many different patches of habitat as a "metapopulation."[253] For example, frogs,turtles, muskrats, and

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246. *See* Robert Poulin & Serge Morand, *The Diversity of Parasites*, 75 Q. REV. BIOLOGY 277 (2000) (practically all free-living multicellular animals harbor one or more parasite species).

247. Gretchen C. Daily, *Developing a Scientific Basis for Managing Earth's Life Support Systems*, 3 CONSERVATION ECOLOGY (2) 14, *available at* http://www.consecol.org/vol3/iss2/art14 (last visited Sept. 15, 2001) (a substantial portion of biodiversity occurs in human-dominated habitats); Wu & Loucks, *supra* note 129, at 460 (hierarchical patch dynamics emphasizes, rather than avoids, heterogeneity).

248. *See, e.g.*, BROWN, *supra* note 52, at 201.

249. In many ways, variability in space and in time is interchangeable . . . . Strategies have evolved to deal with unpredictability; greater predictability may be achieved by averaging over space, through dispersal, or over time, through dormancy or by becoming perennial. Space and time are two different ways for . . . reducing risk while eschewing potentially larger payoffs; evolution is for the long haul.

LEVIN, *supra* note 91, at 74.

250. Holling, *supra* note 139, at 479.

251. Timothy Beatley, *Preserving Biodiversity: Challenges for Planners*, 66 J. AM. PLAN. ASS'N 5, 10-13 (2000).

252. *See* H. Ronald Pulliam, *Sources, Sinks, and Population Regulation*, 132 AM. NATURALIST 652 (1988). *See* NAT'L RESEARCH COUNCIL, *supra* note 227, at 98-99.

253. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF FEDERAL ACTIVITIES, CONSIDERING ECOLOGICAL PROCESSES IN ENVIRONMENTAL IMPACT ASSESSMENTS 72 (1999). A metapopulation has been defined as "a population of local populations linked by exchanges of individuals." FARINA, *supra* note 110, at 81.

other wetland animals raise more young than can occupy their home wetland. The young disperse throughout the surrounding area in search of other wetland sites. As long as there are enough wetland sites within dispersal range, a wetland can be recolonized even if the local population goes extinct.[254] The study of the dynamics of movement by individual animals among habitat patches (that are themselves transient) has produced some of the most interesting ecological research in recent years and has created a new subspecialty known as "metapopulation ecology."[255]

Metapopulation ecologists rely heavily on computer models.[256] The models forecast the size and relative location of patches that will be needed to sustain a species of particular dispersal capability.[257] Both metapopulation and landscape ecologists increasingly tend to use the terminology developed by H. Ronald Pulliam, who divides habitats for a particular species into "sources, sinks and traps." Sources are habitats in which the species can reproduce successfully; i.e., where the birth rate is higher than the death rate. Sinks are habitats in which a species can survive, but not thrive, because the death rate exceeds the birth rate, but the species continues to be found in such habitats because young individuals move into the habitat after they leave their parents. Traps are habitats that appear to be suitable breeding sites to the species, but in fact are not. For example, a farmer's hay field may attract nesting birds every year even though the nesting always fails because the hay is cut before the birds fledge.[258]

Do source habitats automatically deserve more protection than sinks?[259] This idea is intuitively appealing, but a habitat that

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254. NOSS & COOPERRIDER, *supra* note 194, at 61-62. Not all species exhibit metapopulation behavior. Peggy L. Fiedler et al., *The Paradigm Shift in Ecology and Its Implications, in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 83, 99-100 (Steward Pickett et al. eds, 1997).

255. Finnish ecologist Ilkka Hanski has published extensively in this field. *See generally* ILKKA A. HANSKI, METAPOPULATION ECOLOGY (1999).

256. *See generally* Ilkka Hanski, *Metapopulation Dynamics*, 396 NATURE 41 (1998) (reviewing metapopulation modeling studies); METAPOPULATION BIOLOGY: ECOLOGY, GENETICS AND EVOLUTION (Ilkka Hanski & Michael E. Gilpin eds., 1997) (providing an updated survey of emerging metapopulation biology theories.).

257. *See* Ilkka Hanski & Otso Ovaskainen, *The Metapopulation Capacity of a Fragmented Landscape*, 404 NATURE 755 (2000) (proposing model for estimating capacity of patchy habitat to support particular species). *But see* Susan Harrison, *Metapopulations and Conservation, in* LARGE-SCALE ECOLOGY AND CONSERVATION BIOLOGY 111,123 (P.J. Edwards et al. eds, 1993) (arguing that metapopulation behavior may apply only to relatively few species).

258. H. Ronald Pulliam, *Sources and Sinks: Empirical Evidence and Population Consequences, in* POPULATION DYNAMICS IN ECOLOGICAL SPACE AND TIME 45, 55-56 (Olin E. Rhodes, Jr. et al. eds., 1996). Similar conditions apply to plants, many of which disperse seeds into areas where the plant can persist but not thrive. FARINA, *supra* note 110, at 77-78.

259. *See* A. Townsend Peterson, *Endangered Species and Peripheral Populations: Cause for*

appears to be a sink[260] may be occupied by transient individuals on the way to new source habitats.[261] Also, the study of patch dynamics has made us aware of the extent to which patterns of habitat change over time,[262] so that in many situations, sinks are an important component of spatial structure and contribute to the persistence of species.[263]

Patch dynamics and metapopulation dynamics have raised new questions about the extent to which large areas of undifferentiated habitat are more important for the protection of biodiversity than mosaics of small patches of different habitats.[264] After long debate, by the early 1990s most biologists seemed to agree that preservation of large, contiguous habitats was preferable to preservation of a similar area of land divided into smaller reserves.[265]

Reflection, 18 ENDANGERED SPECIES UPDATE 30, 31 (2001) (future efforts should concentrate on "areas in which probabilities of success are high."). *See also* U.S. EPA, OFFICE OF FED. ACTIVITIES, CONSIDERING ECOLOGICAL PROCESSES IN ENVIRONMENTAL IMPACT ASSESSMENTS 72 (1999) ("Preservation of sink populations alone cannot protect a species.").

260. With many kinds of animals, the problem of identifying which patches are sinks and which are sources is extremely difficult. *See* Scott K. Robinson, *Nest Gains, Nest Losses*, *in* SCIENTISTS ON BIODIVERSITY 79, 80 (Linda Koebner et al. eds., 1998) (discussing difficulty of correlating predation and brood parasitism records with species population counts).

261. Mark E. Ritchie, *Populations in a Landscape Context: Sources, Sinks and Metapopulations*, *in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 160, 176, 179-180 (John A. Bissonette ed., 1997). The very definition of habitat depends on how many species are present in an area. More diverse habitats result in more species. But which comes first? At very large geographic scales, "the more species, the more habitats [the biologists] recognize." At smaller scales, it is the variation in habitat that controls. MICHAEL L. ROSENZWEIG, SPECIES DIVERSITY IN SPACE AND TIME 175-76 (1995). "Species discriminate habitats because natural selection forces them to. The more species, the more narrowly they specialize. The more they specialize, the more the ecologist sees different habitats." *Id.* at 189.

262. S.T.A. Pickett & Kevin H. Rogers, *Patch Dynamics: The Transformation of Landscape Structure and Function*, *in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 101, 102 (John A. Bissonette ed., 1997).

263. Some ecologists suggest that the habitats with the most diversity of species are likely to be sinks. FARINA, *supra* note 110, at 80. MAURER, *supra* note 102, at 152. "Remnant" populations of plants may survive in sinks for long periods of time. Ove Eriksson, *Functional Roles of Remnant Plant Populations in Communities and Ecosystems*, 9 GLOBAL ECOLOGY & BIOGEOGRAPHY 443 (2000).

264. Many of the studies on which the preference for large blocks of similar habitat were based involved studies of forest birds, some of which clearly seem to prefer large areas of deep woods. *See e.g.*, D.M. Burke & E. Nol, *Landscape and Fragment Size Effects on Reproductive Success of Forest-Breeding Birds in Ontario*, 10 ECOLOGICAL APPLICATIONS 1749, 1757 (2000). Recently, a committee of the Ecological Society of America approached this issue cautiously, pointing out that landscape fragmentation does not necessarily destroy ecological functions or decrease biodiversity, and that making a naturally patchy landscape more uniform may have adverse effects, but also concluding that large decreases in the size of habitat patches or increases in the distance between them can reduce biodiversity and alter ecological system processes. Dale et al., *supra* note 47, at 654-55.

265. *See* Ruhl, *supra* note 126, at 966.

The island biogeography theory[266]developed by Robert H. MacArthur and Edward O. Wilson in the 1960s[267] was one of the most influential works on ecology in that period.[268] They proposed a mathematical formula to determine how many species of any given taxa would be found on an island. In general, the number of species increased with the size of the island and the biotic richness of the region and decreased with the distance of the island from sources of immigration.[269]

Ecologists soon began to think that the model applicable to islands could be applied more generally to all sorts of patches of habitat in a heterogeneous environment, and each patch could be treated as an island surrounded by something different.[270] Disconnected mountaintops, for example, might be effectively isolated "islands" because few species could successfully traverse the terrain between them.[271]

Studies of forest birds found that a number of species could successfully reproduce only in large patches of undisturbed forest.[272] It appeared that many forest birds reproduced most successfully if they were a long distance from the edge of the forest. Near the edge of the forest, they were exposed to greater effects of predation and egg substitution by animals such as raccoons and cowbirds that avoided the deep forest.[273] This is often referred to as the "edge effect."[274]

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266. For a concise description of island biogeography theory, see A. Schoener, *Experimental Island Biogeography*, *in* ANALYTICAL BIOGEOGRAPHY: AN INTEGRATED APPROACH TO THE STUDY OF ANIMAL AND PLANT DISTRIBUTIONS 483, 487-488 (A.A. Myers & Paul S. Giller eds., 1988). For a discussion of the origins of island biogeography theory, see WORSTER, *supra* note 167, at 375-78. For a thorough analysis of biogeography of islands, see ROBERT J. WHITTAKER, ISLAND BIOGEOGRAPHY: ECOLOGY, EVOLUTION, AND CONSERVATION (1998).

267. ROBERT H. MACARTHUR & EDWARD O. WILSON, THE THEORY OF ISLAND BIOGEOGRAPHY (1967).

268. WHITTAKER, *supra* note 266, at 113-14.

269. *Id.* at 115.

270. MCINTOSH, *supra* note 50, at 280-83.

271. DAVID QUAMMEN, THE SONG OF THE DODO: ISLAND BIOGEOGRAPHY IN AN AGE OF EXTINCTIONS 438-39 (1996). Recent studies of hilltops in Venezuela that became isolated islands when a new dam created a large reservoir have illustrated the serious loss of biodiversity that such isolation can create. John Terborgh et al., *Ecological Meltdown in Predator-Free Forest Fragments*, 294 SCI. 1923 (2001). *See also* Jared Diamond, *Dammed Experiments!*, 294 SCI. 1847 (2001).

272. The classic study is Chandler S. Robbins et al., *Habitat Area Requirements of Breeding Forest Birds of the Middle Atlantic States*, 103 WILDLIFE MONOGRAPHS 1 (1989). For an example of a recent study, see Christine A. Howell et al., *Landscape Effects Mediate Breeding Bird Abundance in Midwestern Forests*, 15 LANDSCAPE ECOLOGY 547 (2000).

273. ROBERT A. ASKINS, RESTORING NORTH AMERICA'S BIRDS: LESSONS FROM LANDSCAPE ECOLOGY 110-16 (2000).

274. Hendrik Andrén, *Effects of Landscape Composition on Predation Rates at Habitat Edges*, *in* MOSAIC LANDSCAPES AND ECOLOGICAL PROCESSES 225, 225 (Lennart Hansson et al. eds., 1995).

The similarity of a fragmented forest to islands in a sea led to attempts to apply island biogeography theory to forests. Much of the concern over habitat fragmentation grows out of studies showing that many species of birds and large predators are dependent on relatively large blocks of forest in order to reproduce.[275] This fear of expanding edge effects led many conservation biologists to prefer protection of large, undifferentiated habitats rather than heterogeneous mixtures of habitat patches.[276]

In *Sierra Club v. Marita*,[277] the Sierra Club sought to convince the federal courts that large areas of homogeneous forest are always better biologically than smaller patches. The case involved the adoption of forest management plans for two national forests in northern Wisconsin.[278] The court of appeals was unconvinced and deferred to the United States Forest Service's opinion that the merits of large homogeneous forests were not clearly established.[279] Was the Sierra Club's argument that larger reserves are always better scientifically sound?

Some species of forest birds may spend all of their lives in the dense forest and depend solely upon it, but many others rely not only on the forest but also on other types of habitat, moving between different habitats as they feed, breed, and seek shelter.[280] Ecotones – the boundaries between different types of habitat – are generally characterized by high biological diversity.[281] Ecologists increasingly recognize that ecotones are important zones in their

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275. *See, e.g.*, D.M. Burke & Erica Nol, *Landscape and Fragment Size Effects on Reproductive Success of Forest-breeding Birds in Ontario*, 10 ECOLOGICAL APPLICATIONS 1749, 1757 (2000); Gretchen C. Daily et al., *Countryside Biogeography: Use of Human-dominated Habitats by the Avifauna of Southern Costa Rica*, 11 ECOLOGICAL APPLICATIONS 1 (2001) (reporting that at least half of the bird species of Southern Costa Rica seem to have no prospects for survival outside of the forest).

276. *See, e.g.*, RICKLEFS, *supra* note 58, at 610; Bradley C. Karkkainen, *Biodiversity and Land*, 83 CORNELL L. REV. 1, 11-14 (1997) (describing broad but not universal consensus on protection of large reserves connected by corridors).

277. 46 F.3d 606 (7th Cir. 1995).

278. *Id.* at 608-09.

279. *Id.* at 619-24.

280. Pickett & Rogers, *supra* note 116, at 101, 104 (Organisms may require a "commodious mixture of . . . patch types" at various stages of their life cycle or at different seasons of the year). Where dispersal rates are particularly high, many singleton species will be found in sink conditions, and the richness of species in the area will seem abnormally high. HUBBELL, *supra* note 39, at 315-16.

281. VEGETATION MAPPING FROM PATCH TO PLANET, *supra* note 13, at 328 (noting increasing recognition that habitat zones have fuzzy edges). *See also* Marjorie M. Holland & Paul G. Risser, *Introduction to* ECOTONES: THE ROLE OF LANDSCAPE BOUNDARIES IN THE MANAGEMENT AND RESTORATION OF CHANGING ENVIRONMENTS 1 (Marjorie M. Holland et al. eds., 1991). In the western United States, grazing may increase local biodiversity in some areas but may be reducing biodiversity at larger scales. DEBRA L. DONAHUE, THE WESTERN RANGE REVISITED: REMOVING LIVESTOCK FROM PUBLIC LANDS TO CONSERVE NATIVE BIODIVERSITY 163-69 (1999).

own right and can no longer be treated merely as lines on a map.[282] Connecticut College ecologist Robert Askins notes that the fragmentation of Eastern forests may provide some biodiversity benefits by creating good habitat for shrubland birds, such as Yellow-breasted chats, White-eyed vireos, and Chestnut-sided warblers, whose numbers are declining.[283]

Most ecologists today believe that "the debate about the effectiveness of a single large reserve as opposed to several small ones is far from being resolved."[284] In general, the larger the area one looks at, the more species it is likely to have, regardless of the degree of heterogeneity.[285] University of Arizona biologist Michael Rosenzweig points out that if area is kept equal, studies show that "species diversity rises with habitat diversity."[286] More recent metapopulation theories have emphasized the important role that discontinuous patches may play in protecting species from the impact of widespread epidemic or conflagration.[287] Forest diversity is enhanced when a variety of successional stages are represented. For example, when a storm or the death of a large tree opens a new

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282. M.-J. Fortin et al., *Issues Related to the Detection of Boundaries*, 15 LANDSCAPE ECOLOGY 453, 462 (2000) (suggesting that more sophisticated mapping of ecotones is needed).

283. ASKINS, *supra* note 273, at 48-49. Recent studies suggest that in North America the birds that occupy disturbed habitats have suffered greater population declines than the species that occupy mature forests. This is assumed to be the result of fire and flood suppression. Jeffrey D. Brawn, *The Role of Disturbance in the Ecology and Conservation of Birds*, 32 ANN. REV. ECOLOGY & SYSTEMATICS 251 (2001). The development of ecological models that predict the impact of fragmentation of plants and animals has proven to be difficult. *See, e.g.*, S.A. Bailey et al., *Habitat Fragmentation in England's Ancient Woods: Implications for Managing Biodiversity*, *in* HETEROGENEITY IN LANDSCAPE ECOLOGY 225 (M.J. Maudsley & E.J.P. Marshall eds., 1999).

284. NAT'L RESEARCH COUNCIL, *supra* note 227, at 136. Advances in computational ability and model design are now beginning to make it possible to combine metapopulation models with patch dynamic models; one such study concluded that the size of a reserve area may be of less importance than its degree of persistence over time. Juan E. Keymer et al., *Extinction Thresholds and Metapopulation Persistence in Dynamic Landscapes*, 156 AMERICAN NATURALIST 478, 490 (2000). *See also* JAMES H. BROWN & MARK V. LOMOLINO, BIOGEOGRAPHY 565 (2d ed. 1998) (reporting that science cannot definitively say whether large or small reserves are better).

285. MICHAEL A. HUSTON, BIOLOGICAL DIVERSITY: THE COEXISTENCE OF SPECIES ON CHANGING LANDSCAPES 35 (1994).

286. ROSENZWEIG, *supra* note 261, at 210 (but not on islands, where other variables need to be considered *Id.* at 263). *See also* Pickett & Rogers, *supra* note 116, at 107 (holding that patchiness contributes to biodiversity).

287. Ilkka Hanski & Daniel Simberloff, *The Metapopulation Approach: Its History, Conceptual Domain, and Application to Conservation*, *in* METAPOPULATION BIOLOGY: ECOLOGY GENETICS AND EVOLUTION 5, 20-21 (Ilkka Hanski & Michael E. Gilpin eds., 1997). The authors say that there has been a "paradigm shift" away from island biogeography to metapopulation theory (*Id.* at 16-19), but that the cost of metapopulation studies has often proved to be too great for ecosystem management programs (*Id.* at 26); David J.D. Earn et al., *Coherence and Conservation*, 290 SCI.1360 (2000) (proposing model to test whether corridors connecting habitat patches are helpful or harmful.). *See also* NAT'L RESEARCH COUNCIL, *supra* note 227, at 101.

patch in the forest, it then receives more sunlight and becomes populated with new species. As that patch gets older, another new patch forms elsewhere, so that the "natural forest becomes a tapestry of patches in different stages of succession, and hence a tapestry of diversity."[288]

The forests of northern Wisconsin were not homogeneous in their natural state: "Contrary to romantic imagination, Wisconsin's forests before Anglo-American settlement were not one ideal homogeneous stand of virgin white pine stretching across its expanse. In reality, Wisconsin's 'true' forest was neither 'piney' nor 'virgin.'" It was "ever-evolving and changing, differing in geology, soil conditions, disease, insects, windfalls, natural forest fires, and simply old age."[289] Today, more sophisticated studies of heterogeneous habitats view the island analogy as "superficial."[290] In terrestrial environments, the matrix (i.e., the spaces surrounding the patches) cannot be treated as a black hole in the way the ocean is treated in island biogeography models. As one ecologist recently put it, "the matrix matters."[291]

So is the preference for large habitat patches misguided? The distinguished British biologist Robert May says "[t]here is no doubt that the diversity of life on earth would be less if terrestrial and marine environments were significantly more homogeneous than they are."[292] Where a metapopulation of a species is distributed among many patches, and there is opportunity for movement among the patches, the risk that predation, disease, or some unpredictable environmental event will cause the extinction of the entire population is substantially reduced.[293] Thus, for species with

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288. LEVIN, *supra* note 91, at 88. *See, e.g.*, David B. Lindenmayer et al., *Effects of Forest Fragmentation on Bird Assemblages in a Novel Landscape Context*, 72 ECOLOGICAL MONOGRAPHS 1 (2002) (large scale study of eucalyptus forests in Australia shows that forest patches of all sizes have significant conservation value because some native species are more abundant in smaller patches).

289. ANTHONY GODFREY, A FORESTRY HISTORY OF TEN WISCONSIN INDIAN RESERVATIONS UNDER THE GREAT LAKES AGENCY: PRECONTACT TO PRESENT 4 (1996).

290. "The superficial similarities between oceanic islands and community fragments mask fundamental differences in history, age, internal habitat conditions, and surrounding matrices." Martin Kellman, *Redefining Roles: Plant Community Reorganization and Species Preservation in Fragmented Systems*, 5 GLOBAL ECOLOGY AND BIOGEOGRAPHY LETTERS 111, 111 (1996).

291. Taylor H. Ricketts, *The Matrix Matters: Effective Isolation in Fragmented Landscapes*, 158 AM. NATURALIST 87 (2001).

292. Robert M. May & T R.E. Southwood, *Introduction to* LIVING IN A PATCHY ENVIRONMENT 1, 13-14 (Bryan Shorrocks & Ian R. Swingland eds., 1990). "At landscape scales spatial heterogeneity, or patchiness, in the environment offers the possibility of regional coexistence in spite of local extinction." HUSTON, *supra* note 285, at 88.

293. May & Southwood, *supra* note 292, at 6. Metapopulation theories have led to a burst of empirical research on the dispersal abilities of various species. *See, e.g.*, Niklas Wahlberg et al., *Metapopulation Structure and Movements in Five Species of Checkerspot Butterflies*,

good dispersal capabilities, increased habitat fragmentation may reduce the risk of extinction.[294]

There is no doubt that the destruction of huge tracts of tropical forest is driving to extinction many species, undoubtedly including some that will never have been identified.[295] So little is known about the ecology of tropical forests that scientists fear that logging and burning will destroy unique attributes of the forest before we fully understand them.[296] But the problems are caused by the vast scale of forest destruction, rather than by fragmentation.[297] Many ecologists view deforestation as "largely a tropical issue,"[298] although the logging of the old growth forests of the Northwestern United States has also been very controversial.[299] I do not mean to minimize the importance of deforestation, which has implications for climate as well as biodiversity, but I believe it is inappropriate to characterize it as a fragmentation problem.

Isolated fragments of landscape elements are often critical habitats for rare species.[300] For example, in the Southern

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130 OECOLOGIA 33 (2002).

294. Mark E. Ritchie, *Populations in a Landscape Context: Sources, Sinks and Metapopulations, in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 160, 172-75, 181 (John A. Bissonette ed., 1997). *See* HUBBELL, *supra* note 39, at 228. (suggesting the impact of fragmentation is primarily in its effect on mean dispersal rates). "[O]ne can predict both the species richness and relative species abundance in a metacommunity undergoing zero-sum ecological drift" from the "area and the average speciation rate in the biogeographic region, the density of organisms per unit area, and . . . the mean dispersal rate of species over the landscape." *Id.* at 149.

295. T. C. Whitmore, *Tropical Forest Disturbance, Disappearance, and Species Loss, in* TROPICAL FOREST REMNANTS: ECOLOGY, MANAGEMENT, AND CONSERVATION OF FRAGMENTED COMMUNITIES 3, 11 (William F. Laurance & Richard O. Bierregaard, Jr. eds., 1997). In addition to the adverse impact on biodiversity, tropical forest destruction is aggravating the trend toward global warming. NAT'L RESEARCH COUNCIL, *supra* note 7, at 48.

296. In the last 50 years, 9,000,000 square kilometers of tropical forest have been lost. Stuart L. Pimm et al., *Can We Defy Nature's End*?, 293 SCI. 2207, 2207 (2001). For a concise summary of the problems of fragmentation of tropical forests, see William F. Laurence et al., *Tropical Forest Fragmentation: Synthesis of a Diverse and Dynamic Discipline, in* TROPICAL FOREST REMNANTS: ECOLOGY, MANAGEMENT, AND CONSERVATION OF FRAGMENTED COMMUNITIES 502 (William F. Laurance & Richard O. Bierregaard, Jr. eds., 1997).

297. EDWARD O. WILSON, THE FUTURE OF LIFE 58-66 (2002); Osvaldo E. Sala et al., *Global Diversity Scenarios for the Year 2100*, 287 SCI. 1770-71 (2000). *See generally* K.D. Singh, *Rainforest Loss and Change, in* 5 ENCYCLOPEDIA OF BIODIVERSITY 25 (Simon A. Levin ed., 2001).

298. Jaboury Ghazoul & Julian Evans, *Deforestation and Land Clearing, in 2* ENCYCLOPEDIA OF BIODIVERSITY 23, 35 (Simon A. Levin ed., 2001). *See also* G. Arturo Sánchez-Azofeifa et al., *Deforestation in Costa Rica: A Quantitative Analysis Using Remote Sensing Imagery*, 33 (3) BIOTROPICA 378 (2001).

299. *See generally* R. EDWARD GRUMBINE, GHOST BEARS: EXPLORING THE BIODIVERSITY CRISIS (1992).

300. Mark E. Ritchie, *Populations in a Landscape Context: Sources, Sinks and Metapopulations, in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 160, 181 (John A. Bissonette ed., 1997) (noting that species that prefer rare habitats are more likely to go extinct).

Appalachians, 84% of the federally listed species occur in rare habitat communities.[301] The retention of even small, apparently relict fragments of lost landscapes may be important as source material if future environmental changes make it possible to recreate earlier conditions.[302] Many ecologists believe that insufficient attention is being paid to the management needs of such fragments.[303]

On the other hand, where human activities have reduced natural habitats to small patches, the adverse impact on ecological systems can be severe.[304] In much of the Florida landscape, for example, the habitat fragments may be too small to support either closed-canopy forest species that need to be a substantial distance from the edge of the habitat or wide-ranging species such as the Florida panther.[305] Small reserves increase our need to create connecting corridors[306] and to be prepared to reintroduce predators into the system, because species at the top of the food chain may be at great risk of localized extinction as the size of habitats diminish, and such species may be essential for the protection of the ecological system.[307]

No one is arguing that fragmentation is always desirable, but current research makes it apparent that the blanket condemnation of fragmentation that still appears in much of the conservation biology literature[308] needs to be replaced by a more nuanced look at the pros and cons of large and small habitat patches in particular situations.[309]

C. Disturbance of Ecological Systems Doesn't Always Mean Destruction

Ecological change caused by natural disturbance is not only inevitable but, within limits, necessary if ecological processes are to be maintained. This current view is a departure from much of the

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301. Dale et al., *supra* note 47, at 659.

302. ASKINS, *supra* note 273, at 235-36. *See also* Kellman, *supra* note 290, at 114 (suggesting that extreme fragmentation may be a temporary phenomenon).

303. Kellman, *supra* note 290, at 111-12.

304. U.S. EPA, *supra* note 227, at 17-18. *See, e.g.*, Jennifer J. Swenson & Janet Franklin, *The Effects of Future Urban Development on Habitat Fragmentation in the Santa Monica Mountains*, 15 LANDSCAPE ECOLOGY 713 (2000) (modeling edge effects of various urban development patterns).

305. Harris, *supra* note 172, at 337-38. *See also* Reed F. Noss, *Protecting Natural Areas in Fragmented Landscapes*, 7 NAT. AREAS J. 2, 3 (1987).

306. *See generally* ANDREW F. BENNETT, LINKAGES IN THE LANDSCAPE: THE ROLE OF CORRIDORS AND CONNECTIVITY IN WILDLIFE CONSERVATION (IUCN 1999).

307. ROSENZWEIG, *supra* note 261, at 383.

308. *See, e.g.*, ANDREW P. DOBSON, CONSERVATION AND BIODIVERSITY 33-57 (1996).

309. NAT'L RESEARCH COUNCIL, *supra* note 7, at 50.

earlier ecological thinking, which endorsed the idea of a natural succession of types of species that would each occupy an area in turn, leading up to a climax condition that represented equilibrium – with the result leading to realization of the ancient religious belief in a "balance of nature."[310]

1. The Impermanence of Climax Communities

Frederic Clements, the most prominent ecologist of the early twentieth century, posited that each piece of the landscape had a natural condition of "equilibrium" that it would achieve if left alone.[311] Clements wrote extensively about natural processes by which one plant community is replaced by another in successive waves.[312] He noted that certain pioneer species were adept at moving into new environments and multiplying rapidly,[313] but they would eventually be replaced ("succeeded") by more long-lived species that would eventually form the "climax" community when a state of "equilibrium" was reached.[314] Each plant and animal species would then occupy its niche permanently.[315]

For example, in the central United States, Clements described how an area of bare sand would become colonized by cottonwoods, which would be replaced by jack pines growing up in the shade of the cottonwoods, which then would be replaced by black oaks, white oaks, and red oaks in turn, which would finally give way to the climax forest of beech and maple.[316] Of course, the forest might be disturbed by fire, insect epidemic, or other natural event,[317] but in

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310. The scientific acceptance of the idea that a "balance of nature" exists can be traced back to the great Swedish systematist, Carl von Linné, known as Linnaeus, whose eighteenth-century treatise was widely admired. CARL VON LINNÉ, THE OECONOMY OF NATURE (1749). Linnaeus postulated that the Creator had devised a perfectly static world in which the relationships of every living creature were in balance with each other and their surroundings. WORSTER, *supra* note 167, at 35-36. Ecologists were sometimes criticized for unrealistic assumptions about a balanced nature. *See, e.g.*, PETER ROGERS, AMERICA'S WATER: FEDERAL ROLES AND RESPONSIBILITIES 81 (1993) ("The theories underlying the ecological approach to natural resources policies rely heavily on scientific analyses of individual components pieced together with a not altogether scientifically defensible idea of nature's balance.").

311. Frederic E. Clements, *Nature and Structure of the Climax*, 24 J. ECOLOGY 252, 256 (1936).

312. *See e.g.*, JOHN WEAVER & FREDERIC E. CLEMENTS, PLANT ECOLOGY 60-79 (2d ed. 1938).

313. For a summary of Clements' ideas about succession, see KREBS, *supra* note 154, at 483-85.

314. Clements, *supra* note 311, at 255-56.

315. KREBS, *supra* note 154, at 483-85.

316. *See* WEAVER & CLEMENTS, *supra* note 312.

317. Norman Christensen suggests that a century ago, management of wilderness preserves was "seen as operationally equivalent to museum curation on a grand scale." Christensen, *supra* note 172, at 175. Clements and others viewed fire and other disturbances as negative events that prevented ecosystems from attaining or maintaining their climax

the long run it wouldn't matter because the process of succession would begin again and the habitat eventually return to the climax condition.[318]

Over time, ecologists increasingly began to question the validity of the ideas of equilibrium and the balance of nature. By the 1970s, extended critiques of the concept of equilibrium had begun to appear.[319] In the 1980s, a new paradigm began to be discussed.[320] One of its earliest proponents, Steward Pickett, argued that the processes by which ecological systems undergo change are an essential element of the ecological systems' makeup. "Thus, rather than viewing ecosystems as being 'in balance,' systems are seen as in flux . . . ."[321] University of Illinois wildlife law expert Eric Freyfogle summarizes the importance of this change:

> Ecologists now realize that the whole concept of community climax is misleading, for climaxes are always tentative and subject to being upset by a wide variety of natural forces, including fire, disease, and weather. In the north woods, white pine is vulnerable to fire and disease, and when it dies, it opens the way for the jack pine and birch to return. This disease- or fire-driven transition from white pine to jack pine and birch is as natural as the shift onward to balsam and spruce. Animal populations, too, experience wide fluctuations, and in the long

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state. *See* FREDERIC E. CLEMENTS & VICTOR E. SHELFORD, BIO-ECOLOGY 248 (1939) (noting that climax may persist for thousands of years).

318. "While the climax is permanent because of its entire harmony with a stable habitat, the equilibrium is a dynamic one and not static. Superficial adjustments occur with the season, year, or cycle . . . . While change is constantly and universally at work, in the absence of civilized man this is within the fabric of the climax and not destructive of it." WEAVER & CLEMENTS, *supra* note 312, at 80. For a concise summary of the origins of equilibrium theory, see Wu & Loucks, *supra* note 129, at 441-43.

319. *See, e.g.*, Peter S. White, *Pattern, Process, and Natural Disturbance in Vegetation*. 45 BOTANICAL REV. 229, 231 1979) (suggesting that the importance of ongoing dynamics is difficult to reconcile with the idea of equilibrium). For a discussion of the early history of the recognition of the importance of dynamics in ecology, see Donald Worster, *The Ecology of Order and Chaos*, *in* OUT OF THE WOODS: ESSAYS IN ENVIRONMENTAL HISTORY 3, 9-11 (Char Miller & Hal Rothman eds., 1997).

320. For a history of the development of the nonequilibrium paradigm, see Peggy L. Fiedler et al., *The Paradigm Shift in Ecology and Its Implications for Conservation*, *in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 83, 84-87 (Steward T.A. Pickett et al. eds, 1997).

321. V. Thomas Parker & Steward T.A. Pickett, *Restoration as an Ecosystem Process: Implications of the Modern Ecological Paradigm*, *in* RESTORATION ECOLOGY AND SUSTAINABLE DEVELOPMENT 17, 22 (Krystyna M. Urbanska et al. eds, 1997) (noting that ecosystems are open, can be regulated by external processes, and are subject to natural disturbances.)

> run, climatic changes bring even greater alterations. The idea of the climax having lost much of its explanatory force, ecologists today speak about nature in terms that are far more fluid. Some species are expanding their range at any time, while others are contracting. New forms are emerging, particularly at the microscopic level. Images of conflict have yielded to more mixed images that include large doses of symbiosis and cooperation.[322]

My colleague, Dan Tarlock, has chronicled how this new focus on the tendency of natural areas to change over time has become the key element of "nonequilibrium" ecology,[323] a theory that contrasts sharply with earlier ideas of a "balance" of nature.[324] The basic premise of nonequilibrium ecology has become widely accepted by mainstream ecologists, as exemplified by the report of a committee of the Ecological Society of America: "Ecological processes function at many time scales, some long, some short; and ecosystems change through time."[325] These changes follow patterns that are predictable only at broad landscape levels.[326] The idea that ecological systems are fluid networks[327] that change and interrelate in cyclical fashion has suggested to many ecologists that their science should emphasize the identification and analysis of these cycles in an attempt to build a four dimensional picture of the natural environment.[328]

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322. ERIC T. FREYFOGLE, JUSTICE AND THE EARTH: IMAGES FOR OUR PLANETARY SURVIVAL 129-30 (1993).

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

324. *See generally* Jonathan Baert Wiener, *Beyond the Balance of Nature*, 7 DUKE ENVTL. L. & POL'Y F. 1 (1996).

325. Dale et al., *supra* note 47, at 639.

326. LEVIN, *supra* note 91, at 128 ("Environmental change is constantly shifting the background against which selection is taking place; thus, adaptation occurs on a landscape that is in a perpetual state of oscillation, with peaks dissolving into valleys and new peaks arising from former valleys."). *See generally* DAVID J. MERRELL, THE ADAPTIVE SEASCAPE: THE MECHANISM OF EVOLUTION 137 (1994) (using a stormy sea as the metaphor for the constantly shifting landscape).

327. JIM SANDERSON & LARRY D. HARRIS, LANDSCAPE ECOLOGY: A TOP-DOWN APPROACH 23 (2000) ("An ecosystem is an entity that consists of an abiotic and biotic community that are linked together by the flow of energy through the subentities and the cycling of resources such as water and nutrients.").

328. John A. Wiens, *Metapopulation Dynamics and Landscape Ecology*, *in* METAPOPULATION BIOLOGY: ECOLOGY, GENETICS AND EVOLUTION 43, 47 (Ilkka Hanski & Michael E. Gilpin eds., 1997) ("Elements in a landscape mosaic (patches) vary in quality in both space and time.").

The increasing emphasis on the variability and instability of nature has not been without controversy.[329] Conservation biologists realize that they must challenge the public's notion of a static nature and work toward developing ways for resolving potentially conflicting environmental goals in a variable world.[330]

2. The Irregularity of Succession

Perhaps the most significant change stemming from nonequilibrium ecological theory is its new emphasis on the important role that disturbance, such as wildfire, flood, or epidemic, plays in ecological processes.[331] Contemporary ecology takes the position that, given the proper perspective, those things our society has called "natural disasters" (and ecologists refer to as "disturbances" or "perturbations") are not external to the ecological system but are a vital part of it.[332] Viewed at the proper scale, disturbance can be seen as a necessary ecological process and a stabilizing factor[333] that needs to be understood.[334]

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329. *See* Donald Worster, *The Ecology of Order and Chaos*, *in* OUT OF THE WOODS: ESSAYS IN ENVIRONMENTAL HISTORY 3, 11-13 (Char Miller & Hal Rothman eds., 1997). Those who believe that internal disagreement within a field of study is a sign of intellectual weakness may wish to read philosopher Mark Sagoff's extensive diatribe against the entire field of scientific ecology. Mark Sagoff, *Muddle or Muddle Through? Takings Jurisprudence Meets the Endangered Species Act*, 38 WM. & MARY L. REV. 825, 953 (1997) ("If all that ecosystems offer is a blooming, buzzing confusion of phenomena with no inherent order or direction, then historical narration and the rules of induction exhaust the theoretical armamentarium of ecological science.").

330. Mark W. Schwartz, *Conflicting Goals for Conserving Biodiversity: Issues of Scale and Value*, 14 NAT. AREAS J. 213, 215 (1994). For a perceptive evaluation of current thinking in nonequilibrium ecology as applied by practicing conservation groups, see WILLIAM HOLLAND DRURY, JR., CHANCE AND CHANGE: ECOLOGY FOR CONSERVATIONISTS (1998).

331. Steward T.A. Pickett and P.S. White produced the pioneering synthesis of the important role of disturbance in ecology in 1985. THE ECOLOGY OF NATURAL DISTURBANCE AND PATCH DYNAMICS (Steward T.A. Pickett & P.S. White eds., 1985). For current confirmation of this thesis, see Dale et al., *supra* note 47, at 653 ("The type, intensity and duration of disturbance shape the characteristics of populations, communities, and ecosystems.").

332. *See, e.g.*, Peter R. Grant et al., *Effects of El Niño Events on Darwin's Finch Productivity*, 81 ECOLOGY 2442 (2000) (noting that finches in the Galapagos breed prolifically in El Niño years, but they also take into account the length of time since the last similar event. "Thus perturbations of natural systems can be fully understood only in a broad temporal context."). *See also* Anthony W. King, *Hierarchy Theory: A Guide to System Structure for Wildlife Biologists*, *in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 185, 208 (John A. Bissonette ed., 1997) (suggesting that occasional collapse of a population may be found normal if viewed from a long time frame).

333. R.V. O'NEILL ET AL., A HIERARCHICAL CONCEPT OF ECOSYSTEMS 163-169 (1986); LEVIN, *supra* note 91, at 112 (1999) ("Local variability and heterogeneity provide the material for change." "[D]isturbance and renewal . . . maintain the diversity.")

334. The U.S. EPA recommends that analysis of any ecological system should include an analysis of its "disturbance regime." U.S. EPA, *supra* note 227, at 24-30.

Although disturbance is now understood to be a key element of ecological dynamics, rather than a temporary interruption of equilibrium, the study of disturbance remains at an early stage. University of Florida ecologist Crawford Holling has been one of the most eloquent exponents of the importance of the study of disturbance. Holling argues that because disturbance is a natural part of ecological cycles, ecological sustainability depends on "the capacity to renew after disturbance." It "is the processes of death and renewal rather than those of birth and growth that lie at the heart of sustainability and diversity."[335] Holling finds that many ecological systems exhibit a four-stage cycle, consisting of the two classic stages of Clements' original theory: (1) colonization, in which rapidly reproducing species move in to take over vacant niches, and (2) conservation, in which the colonizing species are joined by and eventually dominated by what Clements called the "climax community."[336] To these traditional phases Holling adds (3) release, which takes place when the climax stage is so dependent on conditions remaining constant that it becomes "brittle," inviting disturbance, such as disease or exotic species invasion. This disturbance is followed by (4) reorganization, in which the ecological system may return to something approximating its earlier state, stabilize in an alternate state,[337] or collapse.[338]

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335. C.S. Holling, *Biodiversity in the Functioning of Ecosystems: An Ecological Synthesis*, *in* BIODIVERSITY LOSS: ECONOMIC AND ECOLOGICAL ISSUES 44, 60-61 (Charles Perrings et al. eds., 1995). As the renowned ornithologist Alexander Skutch puts it, death may be needed to give species adaptability. "Perhaps, in the long history of the living world, species composed of potentially immortal individuals arose, only to become extinct because they lacked the flexibility that death and mutability give a species to adjust to changing conditions." ALEXANDER SKUTCH, HARMONY AND CONFLICT IN THE LIVING WORLD 30 (2000). The most recent collection of work by Holling and his colleagues is PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS (Lance H. Gunderson & C. S. Holling eds., 2002).

336. KREBS, supra note 154, at 485.

337. C.S. Holling et al., *Science, Sustainability and Resource Management*, *in* LINKING SOCIAL AND ECOLOGICAL SYSTEMS: MANAGEMENT PRACTICES AND SOCIAL MECHANISMS FOR BUILDING RESILIENCE 342, 350-52 (Fikret Berkes et al. eds., 1998). The idea of alternate stable states appears to be conjectural. *Compare* Alan A. Berryman et al., *Metastability of Forest Ecosystems Infested by Bark Beetles*, 26 RESEARCHES ON POPULATION ECOLOGY 13, 20 (1984) *with* Johan van de Koppel & Peter M. J. Herman, *Do Alternate Stable States Occur in Natural Ecosystems? Evidence from a Tidal Flat*, 82 ECOLOGY 3449 (2001).

338. Ecologists use a variety of terms to describe the situation in which an ecological system no longer is able to perform its earlier functions, including "collapse" (Mary E. Power & David Tilman, *Challenges in the Quest for Keystones*, 46 BIOSCIENCE 609, 616 (1996)), "flip" (EDWARD B. BARBIER ET AL., PARADISE LOST: THE ECOLOGICAL ECONOMICS OF BIODIVERSITY 26 (1994)), and "breakdown" (Holling et al., *supra* note 337, at 350)). For example, destructive changes to some Western grasslands caused by climate change and overgrazing may already have caused collapse by crossing a threshold to a new ecological state that could not easily be reversed even if grazing were ended. DONAHUE, *supra* note 281, at 145-46; Joseph M. Feller & David E. Brown, *From Old-Growth Forests to Old-Growth Grasslands:*

Duke University ecologist Norman Christensen has emphasized that the limited predictability of such disturbances is a key to the study of them. "Patterns of change are neither perfectly cyclic or linear. Rather successional transitions are often complex and patterns of disturbance and recovery are often greatly affected by 'chance' events, that is, phenomena such as variations in weather that are controlled by factors external to the system being managed."[339]

In contrast to Clements' traditional theory that an area would gradually return to a specific climax condition after disturbance,[340] Holling and many other contemporary ecologists see post-disturbance renewal as a new and highly variable stage of the cycle that can most appropriately be described as reorganization.[341] Some disturbances can carry the ecological system into "quite different stability domains – for example, fire can transform mixed grass and tree savannas into shrub dominated semideserts . . . ."[342] But in other cases, disturbance may be necessary to maintain

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Managing Rangelands for Structure and Function, 42 ARIZ. L. REV. 319, 324 (2000). The opposite of collapse is sometimes referred to as the "health" or "integrity" of an ecological system, but the criteria for defining such conditions remain amorphous. Eric T. Freyfogle, *Illinois Life and an Environmental Testament*, 1997 U. ILL. L. REV. 1081, 1086 (1997). *See, e.g.*, Giulio A. De Leo & Simon A. Levin, *The Multifaceted Aspects of Ecosystem Integrity*, 1 CONSERVATION ECOLOGY 1997, *available at* www.consecol.org/vol1/iss1/art3 (preferring integrity to health as an appropriate concept). "Biological integrity" has sometimes been used to mean the capacity to support the full range of elements and process expected in the natural habitat of the region. NAT'L RESEARCH COUNCIL, *supra* note 3, at 24.

339. Christensen, *supra* note 172, at 178. In his critique of Clements' succession theory, Holling makes four key points: (1) invasion of persistent species during succession can be highly probabilistic; (2) both early and late successional species can be present continuously; (3) disturbances are an inherent part of the internal dynamics, and, in many cases, set the timing of successional cycles; and (4) some disturbances can severely and permanently disrupt the stability of the ecological system. Holling, *supra* note 139, at 480-81. The divergence of emphasis between stability and change can be traced back to the Greek philosophers, Heraclitus and Parmenides. Stan Godlovitch, *Things Change: So Whither Sustainability*, 20 ENVTL. ETHICS 291 (1998).

340. For a summary of Clements' contributions to ecology, see ROBERT P. MCINTOSH, THE BACKGROUND OF ECOLOGY: CONCEPT AND THEORY 42, 43 (1985). The idea of equilibrium still has its supporters, and in appropriate situations it can serve as a baseline for ecological studies. *See, e.g.*, Stuart L. Pimm, *The Complexity and Stability of Ecosystems*, 307 NATURE 321 (1984); Michael G. Neubert & Hal Caswell, *Alternatives to Resilience for Measuring the Responses of Ecological Systems to Perturbations*, 78 ECOLOGY 653 (1997).

341. Species that invade a disturbed area may be highly variable and determined by chance events, and might include what have traditionally been labeled both early and late successional species. Or disturbance can create conditions that favor completely new species that change the basic character of the ecological system. Holling, *supra* note 139, at 481.

342. C.S. Holling, *Biodiversity in the Functioning of Ecosystems, in* Biodiversity Loss: Economic and Ecological Issues 44, 60-61 (Charles Perrings et al. eds.,1992) (citing Mount St. Helens example). For a discussion of the reorganization of the ecological systems after the Mount St. Helens eruption, see Monica G. Turner & Virginia H. Dale, *Fires, Hurricanes, and Volcanoes: Comparing Large Disturbances*, 47 BIOSCIENCE 758 (1997).

existing ecological processes.[343] The study of ecological systems at large space and time scales is advancing our knowledge of the role that disturbance plays in particular habitats.[344]

i. Patterns in Space: The Example of Coral Reefs

Coral reefs are among the most diverse[345] and productive ecological systems in the ocean[346] and are particularly sensitive to impacts from human activities because they depend on clear water to process sunlight.[347] They have long been thought the most confusing and unpredictable of ecological systems.[348]

Today, remote sensing has enhanced scientists' ability to study and compare coral reefs on a worldwide scale.[349] Increasingly, this research has disclosed patterns in what was formerly just confusion.[350] One such pattern that has aroused worldwide concern is what appears to be a widely observed decline of coral reef habitat quality.[351] For example, the extensive coral reef system around Jamaica has been largely destroyed.[352] Although the use of onshore

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343. *See* discussion *infra* notes 419-31.

344. *See, e.g.*, Thomas Brooks & Michael Leonard Smith, *Caribbean Catastrophes*, 294 SCIENCE 1469 (2001) (pointing out that large scale disturbance may have very different ecological impact than repeated small scale disturbances).

345. The phyletic diversity of coral reefs vastly exceeds that of any other habitat on earth. Of the 34 animal phyla, 32 are found on coral reefs. James W. Porter & Jennifer I. Tougas, *Reef Ecosystems: Threats to their Biodiversity*, *in* 5 ENCYCLOPEDIA OF BIODIVERSITY 73, 75 (Simon A. Levin ed., 2001). *See also* PETER F. SALE, THE ECOLOGY OF FISHES ON CORAL REEFS 4 (1991) ("The hundreds, or sometimes thousands, of species of fish present on a coral reef make these as rich or richer than any other environment for fish on earth.").

346. "Complex and productive, coral reefs boast hundreds of thousands of species, many of which are undescribed by science. They are renowned for their beauty, biological diversity and high productivity." Ove Hoegh-Guldberg, *Climate Change, Coral Bleaching and the Future of the World's Coral Reefs*, 50 MARINE & FRESHWATER RESEARCH 839 (1999).

347. U.S. EPA, OFFICE OF WATER, NATIONAL WATER QUALITY INVENTORY: 1998 REPORT TO CONGRESS 120 (1998).

348. Robert M. May, *The Effect of Spatial Scale on Ecological Questions and Answers*, *in* LARGE-SCALE ECOLOGY AND CONSERVATION BIOLOGY 1, 3 (P.J. Edwards et al. eds., 1993). Coral reefs are very patchy environments. SALE, *supra* note 345, at 10.

349. Peter J. Mumby et al., *Spectrographic Imaging: a Bird's-eye View of the Health of Coral Reefs*, 413 NATURE 36 (2001).

350. J.B.C. Jackson, *Adaptation and Diversity of Reef Corals*, 41 BIOSCIENCE 475, 480-81 (1991). A recent study suggests that certain coral reefs are "hotspots" of endemic species. The ten richest centers of endemic species cover only 15.8% of the world's coral reefs but include about half of those species having restricted ranges. Callum M. Roberts et al. *Marine Biodiversity Hotspots and Conservation Priorities for Tropical Reefs*, 295 SCI. 1280 (2002).

351. *See generally* CARL SAFINA, SONG FOR THE BLUE OCEAN 303-434 (1998).

352. Terence P. Hughes, *Catastrophes, Phase Shifts, and a Large-Scale Degradation of a Caribbean Coral Reef*, 265 SCIENCE 1547 (1994); Nancy Knowlton, *Hard Decisions and Hard Science: Research Needs for Coral Reef Management*, *in* CORAL REEFS: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT 183, 184-85 (Marea E. Hatziolos et al. eds., 1997) (maintaining that the healthy appearance of the Jamaican reefs in the 1970's masked the reef's susceptibility to disturbance).

sedimentation and waste disposal,[353] destructive reef-fishing techniques[354] and ocean-fishing techniques[355] have been blamed for some of the damage to coral reefs, many scientists fear that the underlying problem is the inability of coral reef systems to adapt to gradually warming water conditions caused by the increase of greenhouse gases in the atmosphere.[356]

One very noticeable change has been the bleaching of coral reefs in many parts of the world. The brilliant colors of coral reefs are supplied by algae that live in symbiotic relationship with the coral.[357] If the algae die off, the coral turns translucent in a process called bleaching.[358] The widespread bleaching of coral reefs that occurred during the 1997-98 El Niño episode[359] seemed to be far more extensive than the sporadic bleaching that occurred in the past.[360] The connection between bleaching and the increased water temperature during the El Niño was strengthened when the bleaching did not recur after the water temperature dropped in succeeding years.[361] There has been increasing concern that coral reefs will become a casualty of future climate change.[362]

Most scientists realize, however, that the lack of a good history of worldwide baseline data has made it difficult to determine if

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353. James W. Porter & Jennifer I. Tougas, *Reef Ecosystems: Threats to Their Biodiversity*, *in* 5 ENCYCLOPEDIA OF BIODIVERSITY 73, 82-83 (Simon A. Levin ed., 2001).

354. Hughes, *supra* note 352, at 1547-48. Collection of tropical fish for the aquarium market is a problem of increasing concern for the maintenance of coral reef ecological systems. U.S. EPA, OFFICE OF WATER, NATIONAL WATER QUALITY INVENTORY: 1998 REPORT TO CONGRESS 128-29 (1998).

355. Jeremy B.C. Jackson et al., *Historical Overfishing and the Recent Collapse of Coastal Ecosystems*, 293 SCIENCE 629, 631-33 (2001) (noting that large-scale trawling likely removed ocean fish that formerly kept algae and starfish under control).

356. Hoegh-Guldberg, *supra* note 346, at 843-44; Porter & Tougas, *supra* note 353, at 92-94. For a commentary on this thesis, see JAN SAPP, WHAT IS NATURAL?: CORAL REEF CRISIS 189-190 (1999). The United States National Oceanographic and Atmospheric Agency (NOAA) provides regular updates on coral bleaching conditions. *See* http://psbsgi1.nesdis.noaa.gov:8080/PSB/EPS/SST/climohot.html (last visited Mar. 5, 2002).

357. Hoegh-Guldberg, *supra* note 346, at 843-45.

358. JAN SAPP, WHAT IS NATURAL?: CORAL REEF CRISIS 190-91 (1999).

359. Clive Wilkinson et al., *Ecological and Socioeconomic Impacts of 1998 Coral Mortality in the Indian Ocean: An ENSO Impact and a Warning of Future Change?*, 28 AMBIO 188, 189, 192 (1999).

360. Hoegh-Guldberg, *supra* note 346, at 843-845.

361. Janice M. Lough, *Climate Variability and Change on the Great Barrier Reef*, *in* OCEANOGRAPHIC PROCESSES OF CORAL REEFS: PHYSICAL AND BIOLOGICAL LINKS IN THE GREAT BARRIER REEF 269, 275-77 (Eric Wolanski ed., 2001); William Skirving & John Guinotte, *The Sea Surface Temperature Story on the Great Barrier Reef during the Coral Bleaching Event of 1998*, *in* OCEANOGRAPHIC PROCESSES OF CORAL REEFS: PHYSICAL AND BIOLOGICAL LINKS IN THE GREAT BARRIER REEF 301, 305-08 (Eric Wolanski ed., 2001). For a readable summary of the history and current conditions on the Great Barrier Reef, see ROSALEEN LOVE, REEFSCAPE: REFLECTIONS ON THE GREAT BARRIER REEF (2001).

362. Porter & Tougas, *supra* note 345, at 92-94.

recent disturbances exceeded those in previous cycles.[363] We know that over long periods of time coral reefs have survived many changes in the level and temperature of the sea.[364] Our understanding of the ecology of coral reefs, and our ability to determine whether changes in their condition are normal or indicative of collapse, is being greatly advanced by the enhanced ability to compare different reefs around the world with each other and to explore their history over long time periods.[365] Worldwide, long-term monitoring is being established as part of an International Coral Reef Initiative[366] sponsored jointly by the Intergovernmental Oceanographic Commission, the United Nations Environment Program, and the World Conservation Union.[367] This is an example of the kind of international cooperation that is possible through the use of large-scale ecology.[368]

Some biologists are relatively optimistic about the reefs' future. Coral reefs may have greater recovery power than terrestrial ecosystems because the "aqueous medium is considered to buffer local variations and promote long-distance dispersal" thus promoting recolonization and genetic diversity.[369] Many of the coral reefs that are subject to frequent disturbance by tropical storms develop into highly heterogenous habitats in which many species are able to compete with each other because disturbance is frequent enough to prevent competitive exclusion.[370] Some biologists think

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363. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: IMPACT, ADAPTATION AND VULNERABILITY, A REPORT OF WORKING GROUP II OF THE Intergovernmental Panel on Climate Change, *at* www.usgcrp.gov/ipcc/wg2spm.pdf.

364. ROBERT J. WHITTAKER, ISLAND BIOGEOGRAPHY 15-17 (1998).

365. *Compare* David R. Bellwood & Terry P. Hughes, *Regional-Scale Assembly Rules and Biodiversity of Coral Reefs*, 292 SCIENCE 1532 (2001) ("Tropical reef fishes and corals exhibit highly predictable patterns of taxonomic composition across the Indian and Pacific Oceans.") *with* the more pessimistic view expressed a decade earlier in T. J. Done, *Phase Shifts in Coral Reef Communities and Their Ecological Significance*, 247 HYDROBIOLOGIA 121 (1992) ("[w]e do not have a good understanding of how population, community and ecosystem structure and function differ in degraded from un-degraded reefs."). *See also* Robert A. Kinzie III, *Sex, Symbiosis and Coral Reef Communities*, 39 AM. ZOOLOGIST 80 (1999) (suggesting that by studying reefs at larger scales we have a more realistic understanding of their natural processes).

366. Richard Kenchington, *Status of the International Coral Reef Initiative, in* CORAL REEFS: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT 11, 11-14 (Marea E. Hatziolos et al. eds., 1998).

367. Clive Wilkinson & Bernard Salvat, *The Global Reef Monitoring Network: Reversing the Decline of the World's Reefs, in* CORAL REEFS: CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT 16, 17-18 (Marea E. Hatziolos et al. eds., 1998).

368. *See* discussion *supra* notes 23-33.

369. Marjorie L. Reaka-Kudla, *The Global Biodiversity of Coral Reefs: A Comparison with Rain Forests, in* BIODIVERSITY II: UNDERSTANDING AND PROTECTING OUR BIOLOGICAL RESOURCES 83, 101 (Marjorie L. Reaka-Kudla et al. eds., 1997).

370. Jason E. Tanner & Terence P. Hughes, *Species Coexistence, Keystone Species, and Succession: A Sensitivity Analysis*, 75 ECOLOGY 2204, 2217 (1994).

that it is these regularly disturbed reef systems that are most likely to attain a high degree of species richness and to adapt to environmental change.[371] Other scientists have suggested that corals may employ bleaching as a device to rid themselves of suboptimal algae and develop a new symbiosis with algae more adaptable to current environmental conditions.[372] On the other hand, none of these optimistic conjectures can yet be considered anything but a working hypothesis until a better database of large scale ecological data has been accumulated.

ii. Patterns in Time: The Example of Wilderness

The largest category of natural area that the United States has tried to protect is what we call "wilderness." By law, wilderness in the United States is defined as areas that retain their "primeval" character.[373] Does our system of wilderness protection accomplish ecological objectives when viewed from a long-range perspective?[374]

The legal protection of wilderness was not based on the ecological qualities of the chosen areas, but on the impact of these areas on humans. As John Muir put it, in the wilderness, "Nature's peace will flow into you as sunshine flows into trees."[375] The idea that nature has a beneficial impact on human emotions has, of course, a long history,[376] but our modern wilderness preservation laws grew out of an egalitarian New Deal-era desire to improve human character by making it possible for everyone to escape what

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371. RICKLEFS, *supra* note 58, at 565-66 (citing the intermediate disturbance hypothesis, discussed *infra* notes 397-402, as the probable cause of species richness in coral reefs subject to disturbance). Other coral reef ecological systems, which have evolved during stable conditions in areas where storms are infrequent, may have low resilience because there have been few disturbances, and such systems may be unable to restore their original conditions after eutrophication, overfishing, or other significant human-caused disturbances. AnnMari Jansson & Bengt-Owe Jansson, *Ecosystem Properties as a Basis for Sustainability*, *in* INVESTING IN NATURAL CAPITAL: THE ECOLOGICAL ECONOMICS APPROACH TO SUSTAINABILITY 74, 87 (AnnMari Jansson et al. eds., 1994). This hypothesis is conjectural. *See* Robert H. Fraser & David J. Currie, *The Species Richness-energy Hypothesis in a System Where Historical Factors Are Thought to Prevail: Coral Reefs*, 148 AM. NATURALIST 138, 148 (1996) (pointing out that little evidence supports the theory that disturbance promotes species richness in reefs).

372. Andrew C. Baker, *Reef Corals Bleach to Survive Change*, 411 NATURE 765-66 (2001). This theory is conjectural. Hoegh-Guldberg *supra* note 346, at 856. Some biologists suggest that a reduction in the intervals between bleaching episodes could cause a conversion to short-lived coral species. Terence J. Done, *Coral Community Adaptability to Environmental Change at the Scales of Regions, Reefs and Reef Zones*, 39 AM. ZOOLOGIST 66, 73-75 (1999).

373. *See* discussion *supra* notes 379-81.

374. *See generally* NOSS & COOPERRIDER, *supra* note 194, at 172-74.

375. JOHN MUIR, OUR NATIONAL PARKS 42 (Sierra Club Books ed., 1991).

376. *See, e.g.*, RAYMOND WILLIAMS, THE COUNTRY AND THE CITY (1973). Edward O. Wilson suggests that the attraction for nature may be genetically entrained in humans. *See generally* EDWARD O. WILSON, BIOPHILIA (1984).

Bob Marshall, the founder of the Wilderness Society, called the "serious retrogression, physical, moral and mental" that results from living in cities.[377] The idea that humans can experience a spiritual transformation through contact with the wilderness remains a powerful motivation for the protection of large areas unoccupied by humans.[378]

Formal recognition of the wilderness concept reached its peak in the 1960s with the adoption of the Wilderness Act.[379] The Act proposes that Congress shall set aside large tracts of "land retaining its primeval character and influence . . . ."[380] Pursuant to the statute, an area twice the size of Nebraska has been set aside in the western United States to be available only to those who hike and camp.[381] Organizations such as the Sierra Club and the Wilderness Society reflect the views of millions of people who defend "wildness" as a value in its own right, wholly apart from any ecological issues.

Is there an ecological basis for the protection of wilderness? Many designated wilderness areas were undoubtedly available for such designation because humans had passed them by due to their low productivity.[382] High altitudes, low rainfall, or cold temperatures are characteristic of many wilderness areas, and these often signify low ecological productivity as well, so we cannot tie wilderness protection to maintenance of productivity.[383] A recent analysis of endangered species in five states concluded that

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377. ROBERT GOTTLIEB, FORCING THE SPRING: THE TRANSFORMATION OF THE AMERICAN ENVIRONMENTAL MOVEMENT 16 (1993). For a contemporary example of the egalitarian influence on wilderness protection, see Gary Snyder, *The Etiquette of Freedom*, *in* THE WILDERNESS CONDITION: ESSAYS ON ENVIRONMENT AND CIVILIZATION 21, 38 (Max Oelschlaeger ed., 1992) ("We can accept each other all as barefoot equals sleeping on the same ground.").

378. WILSON, *supra* note 297, at 145-48. J. Ronald Engel, *Liberal Democracy and the Fate of the Earth*, *in* SPIRIT AND NATURE: WHY THE ENVIRONMENT IS A RELIGIOUS ISSUE 59, 68 (Steven C. Rockefeller & John C. Elder eds., 1992).

379. The 1964 Wilderness Act is codified at 16 U.S.C. §§ 1131-36 (1964). For the history of the Act's adoption, see Robert L. Glicksman & George Cameron Coggins, *Wilderness in Context*, 76 DENV. U. L. REV. 383, 384-89 (1999). *See also* WILLIAM K. WYANT, WESTWARD IN EDEN 281 (1982).

380. 16 U.S.C. § 1131(c). For a discussion of the operation of the statute in practice, see Robert B. Keiter, *Taking Account of the Ecosystem on the Public Domain: Law and Ecology in the Greater Yellowstone Region*, 60 U. COLO. L. REV. 923, 951-56 (1989).

381. ERIC T. FREYFOGLE, JUSTICE AND THE EARTH: IMAGES FOR OUR PLANETARY SURVIVAL 97 (1993).

382. 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).

383. A study of all nature reserves in the United States, including wilderness areas, found that many were characterized by high elevation and soil of low productivity. J. Michael Scott et al., *Nature Reserves: Do They Capture the Full Range of America's Biological Diversity?*, 11 ECOLOGICAL APPLICATIONS 999, 1003 (2001).

most of the species at risk are those that occupy human-dominated areas, not wilderness.[384] We need to recognize that wilderness areas were not selected on the basis of any ecological criteria.[385]

Few wilderness areas are immune from the changes arising from the operation of patch dynamics.[386] Even with minimal human intrusion, landscape ecological processes are continually causing changes to which organisms respond; for example, warming temperatures have gradually changed habitat conditions in many cold-climate wilderness areas.[387] Also, human activities outside the wilderness areas have removed some of the largest predators, which has had cascading effects down food chains.[388] The reintroduction of large predators into some wilderness areas may help restore ecological balance by reducing overpopulation of deer and other herbivores.[389]

Many conservation biologists would like to redefine wilderness areas originally set aside for other reasons as biodiversity reservoirs that could be expanded.[390] But few of the "hotspots" of rare species or habitats are found in American wilderness areas.[391]

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384. Andrew P. Dobson et al., *Synoptic Tinkering: Integrating Strategies for Large Scale Conservation*, 11 ECOLOGICAL APPLICATIONS 1019, 1019 (2001).

385. Reed Noss, Reconciling Conservation of Species and Ecosystems (A paper delivered at the Conference on Integration across Ecological Scales, Texas A&M University, Feb. 25, 2000.)

386. *See* David M. Graber, *Resolute Biocentrism: The Dilemma of Wilderness in National Parks*, *in* REINVENTING NATURE: RESPONSES TO POSTMODERN DECONSTRUCTION 123, 125-131 (Michael E. Soulé & Gary Lease eds., 1995); Lech Ryszkowski, *The Coming Change in the Environmental Protection Paradigm*, *in* IMPLEMENTING ECOLOGICAL INTEGRITY: RESTORING REGIONAL AND GLOBAL ENVIRONMENTAL AND HUMAN HEALTH 37, 52 (Phillip Crabbé et al. eds., 2000) (noting that all reserves are changing as a result of external impacts).

387. *See* discussion *infra* notes 471-74.

388. Aldo Leopold pioneered in the recognition of predation as an important component of what he called "land health." *See, e.g.*, Aldo Leopold, *The Land-Health Concept and Conservation*, *in* FOR THE HEALTH OF THE LAND 218, 225 (J. Baird Callicott & Eric T. Freyfogle eds., 1999).

389. The legal, scientific, and social implications of reintroduction are quite complex and beyond the scope of this article. *See, e.g.* Wyoming Farm Bureau Fed'n v. Babbitt, 199 F.3d 1224 (10th Cir. 2000) (upholding reintroduction of wolves in Yellowstone). For discussion of the case, see A. Dan Tarlock, *The Future of Environmental "Rule of Law" Litigation*, 17 PACE ENVTL. L. REV. 237, 268-69 (2000) (analyzing Yellowstone wolf reintroduction litigation); Federico Cheever, *From Population Segregation to Species Zoning: The Evolution of Reintroduction Law under Section 10(J) of the Endangered Species Act*, 1 WYO. L. REV. 287, 362-63 (2001).

390. J. Baird Callicott et al., *Current Normative Concepts in Conservation*, 13 CONSERVATION BIOLOGY 22, 32 (1999). A study of the roadless areas in the national forests concluded that the creation of conservation reserves in these areas would substantially increase the amount of reserve area at lower elevations than most wilderness areas. Robert l. DeVelice & Jon R. Martin, *Assessing the Extent to which Roadless Areas Complement the Conservation of Biological Diversity*, 11 ECOLOGICAL APPLICATIONS 1008 (2001).

391. The places on the planet judged by Conservation International to be key areas requiring protection are beautifully photographed and described in RUSSELL W.

From an ecological standpoint, perhaps the most important reason for the preservation of wilderness is the recognition that our scientific understanding of the values of natural areas is still far from perfect.[392] We know that environmental conditions will be changing, though the predictability of such changes remains elusive.[393] The continued existence of large tracts of natural landscape may serve as laboratories in which the ecologists of the future may perfect their craft.[394]

But there is no reason to try to tie wildness and ecology too closely, because we should not be embarrassed to recognize that we have reasons to protect landscapes that are not founded on ecological science.[395] The powerful desire to protect the remaining wilderness areas, as exemplified in the debates over the Arctic National Wildlife Refuge, reflects the importance of the emotional attachment to what are called "existence" values – the desire to know that wild places exist even if one will never utilize them.[396] It is not my intent to disparage these values — only to point out that it is incorrect to think of them as ecological values in any scientific sense.

MITTERMEIER, HOTSPOTS: EARTH'S BIOLOGICALLY RICHEST AND MOST ENDANGERED TERRESTRIAL ECOREGIONS (First English ed., 1999). Similar programs for identifying hotspots of biodiversity have been undertaken by the World Wildlife Fund. DAVID M. OLSON & ERIC DINERSTEIN, THE GLOBAL 200: A REPRESENTATION APPROACH TO CONSERVING THE EARTH'S DISTINCTIVE ECOREGIONS (1998). The Nature Conservancy has long been acquiring land in such areas. Adams, *supra* note 382, at 10-11. It recently acquired an entire Pacific atoll for conservation. Suzanne Case, *Palmyra Atoll: October 31 to November 4, 2000*, 7 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 291 (2001). *See also* Kai N. Lee, *Searching for Sustainability in a New Century*, 27 ECOLOGY L.Q. 913, 921-922 (2001).

392. FREYFOGLE, *supra* note 381, at 99-100.

393. DANIEL B. BOTKIN, NO MAN'S GARDEN: THOREAU AND A NEW VISION FOR CIVILIZATION AND NATURE 239 (2001).

394. *See* Bill Willers, *Toward a Science of Letting Things Be*, *in* UNMANAGED LANDSCAPES: VOICES FOR UNTAMED NATURE 57 (Bill Willers ed.,1999) ("[I]f left alone so that its processes can continue in an unmanaged way, a vast ecosystem . . . becomes a teacher."). Or as Justice Douglas put it, man will recognize the elements of the wilderness as "links in a chain of which he too is a part" and "perhaps solve some of its mysteries." WILLIAM O. DOUGLAS, MY WILDERNESS: EAST TO KATAHDIN 290 (1961).

395. For an international perspective on the idea of wilderness, see NATURE'S LAST STRONGHOLDS 10-12 (Robert Burton ed., 1991).

396. *See* DAVID W. PEARCE, ECONOMIC VALUES AND THE NATURAL WORLD 21-22 (1993); Howard F. Chang, *An Economic Analysis of Trade Measures to Protect the Global Environment*, 83 GEO. L.J. 2131, 2169-70 (1995) (advocating expansive use of such values); Jan G. Laitos & Thomas A. Carr, *The Transformation on Public Lands*, 26 ECOLOGY L.Q. 140, 227-41 (1999) (suggesting that public support for existence values will dominate use of public lands in the future). For a critique of the methodology by which analysts try to quantify existence values, see Donald J. Boudreaux et al., *Talk is Cheap: The Existence Value Fallacy*, 29 ENVTL. L. 765 (1999).

3. The Rhythm of Disturbance is Crucial

The previous discussion suggests that disturbance itself is not necessarily a danger to ecological systems. In fact, the benefits of disturbance for the maintenance of ecological processes are beginning to be more clearly understood. But ecologists emphasize that disturbance is valuable only as long as the frequency or extent of disturbance does not exceed "normal" limits. To understand what level of disturbance is normal, ecologists need to study disturbance over extended scales of space and time.

i. Disturbance Can Enhance Species Richness

One result of the study of disturbance has been the realization that a certain amount of disturbance seems to be necessary to promote the form of biodiversity known as species richness.[397] Although the relationship between disturbance and diversity is complex, both too much and too little disturbance seem to reduce diversity of species.[398] This phenomenon is familiarly known to ecologists as the "intermediate-disturbance" hypothesis.[399]

Why does diversity of species peak at intermediate disturbance frequencies? If disturbance is too frequent, few species have time to move in and settle. But if disturbance is rare, competition has time to reduce diversity through competitive exclusion. At intermediate levels, more species accumulate before the disturbance, but disturbance happens often enough to slow the process of competitive exclusion.[400] Therefore, although many

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397. Species richness is the diversity of species in a community. It is measured by comparing the number of species in a community to the total number of organisms in the community. A DICTIONARY OF ECOLOGY, *supra* note 147, *at* 380.

398. *See, e.g.*, Warren D. Allmon et al., *An Intermediate Disturbance Hypothesis of Maximal Speciation, in* BIODIVERSITY DYNAMICS: TURNOVER OF POPULATIONS, TAXA AND COMMUNITIES 349 (Michael L. McKinney & James A. Drake eds., 1998); Peter S. White & Jonathan Harrod, *Disturbance and Diversity in a Landscape Context, in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 128, 140-52 (John A. Bissonette ed., 1997).

399. Frank Davis & Max Moritz, *Mechanisms of Disturbance, in* 2 ENCYCLOPEDIA OF BIODIVERSITY 153, 155 (Simon A. Levin ed., 2001); NANAKO SHIGESADA & KOHKICHI KAWASAKI, BIOLOGICAL INVASIONS: THEORY AND PRACTICE 128 (1997). For a history of the theory's origins, see Robert M. May, *The Effects of Spatial Scale on Ecological Questions and Answers, in* LARGE-SCALE ECOLOGY AND CONSERVATION BIOLOGY 1, 4 (P.J. Edwards et al. eds., 1994).

400. *See* ROSENZWEIG, *supra* note 261, at 341-42. *See also* HUSTON, *supra* note 285, at 35 (noting that many studies have found the "highest species diversity occurs at intermediate frequencies of disturbance, with low diversity at both very high and very low frequencies."); Peter Chesson & Nancy Huntly, *The Roles of Harsh and Fluctuating Conditions in the Dynamics of Ecological Communities*, 150 AM. NATURALIST 521, 544 (1997) (modeling suggests that disturbances allow species with differing responses to disturbance to coexist when they might otherwise be excluded by competition). *But see* MUTSONORI TOKESHI, SPECIES COEXISTENCE: ECOLOGICAL AND EVOLUTIONARY PERSPECTIVES 280-281(1999)

species have developed resilient adaptation to certain levels of disturbance,[401] changes in the historical pattern of disturbances would be likely to have an impact on the diversity of species in the area.[402]

ii. Disturbance Can Enhance Resilience

The diversity that results from disturbances may be an advantage to an ecological system because it gives it the "resilience" that will enable it to withstand continuing environmental disruption.[403] The term resilience is increasingly being used to describe the extent to which a natural area can reorganize itself after disturbance.[404] In the language of nonequilibrium ecology, resilience refers to the ability of an ecological system to withstand disturbance without flipping to another stability domain.[405]

Estuaries are an example of a kind of ecological system that often builds up a good deal of resilience. They are often flooded with fresh water by high rains and by salt water from ocean storms, and they may periodically undergo drought.[406] Some estuaries have been subject to a high rate of such disturbance,[407] and ecologists now suspect that it is these disturbances that prevent a small number of species from dominating the estuarine habitat. Estuaries may not build up resilience unless the system has dealt with enough disturbance to preclude competitive exclusion.[408]

Holling suggests that the resilience of ecological systems is determined by the processes by which the systems self-organize

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(maintaining that the intermediate disturbance hypothesis is "disappointingly superficial" because one can always assume a higher or lower rate of disturbance).

401. *See, e.g.* Jones et al., *supra* note 63, at 2628 (noting that cerulean warblers adapted to new territory sizes and nest locations after a severe ice storm in Quebec).

402. Monica G. Turner et al., *Ecological Dynamics at Broad Scales: Ecosystems and Landscapes*, *in* BIOSCIENCE S-29, S-31 (SCIENCE AND BIODIVERSITY POLICY 1995).

403. *See* J.B. Ruhl, *Thinking of Environmental Law as a Complex Adaptive System: How to Clean Up the Environment by Making a Mess of Environmental Law*, 34 HOUS. L. REV. 933, 951-52 (1997).

404. Holling, *supra* note 139, at 481. *See also* RICK POTTS, HUMANITY'S DESCENT: THE CONSEQUENCES OF ECOLOGICAL INSTABILITY 225 (1996).

405. Lance H. Gunderson, *Ecological Resilience – In Theory and Application*, 31 ANN. REV. OF ECOLOGY & SYSTEMATICS 425, 426 (2000). In equilibrium ecology, resilience is related to the ability of an ecological system to return to equilibrium after disturbance. STUART L. PIMM, THE BALANCE OF NATURE? ECOLOGICAL ISSUES IN THE CONSERVATION OF SPECIES AND COMMUNITIES 18 (1991).

406. *See* Giulio A. De Leo & Simon A. Levin, *The Multifaceted Aspects of Ecosystem Integrity*, 1 CONSERVATION ECOLOGY 1997, *available at* www.consecol.org/vol1/iss1/art3.

407. *See, e.g.*, Hans W. Paerl et al., *Ecosystem Impacts of Three Sequential Hurricanes (Dennis, Floyd, and Irene) on the United States' Largest Lagoonal Estuary, Pimlico Sound, NC*, 98 PROC. NAT'L ACAD. SCI. USA 5655 (2001).

408. THE ECOLOGY OF NATURAL DISTURBANCE AND PATCH DYNAMICS, *supra* note 331, at 379.

after disturbance. "Resilience and recovery are determined by the release and reorganization sequence, whereas stability and productivity are determined by the exploitation and conservation sequence."[409] The ability to reorganize, in turn, will be affected by the diversity of species remaining after the disturbance. Species richness is important during periods of environmental fluctuation, when

> . . . the ability to survive rather than efficient function is favored . . . . The presence of a diversity of species and functional types will be of paramount importance for the continuity of ecosystems when faced with environmental shifts . . . . Ecosystems are able to recover because they are formed of many species, each of which has a unique set of characteristics.[410]

This species richness "provides the system with the resilience to respond to unpredictable surprises."[411]

This phenomenon is sometimes referred to as the "insurance effect" of diversity.[412] Ecological systems can be viewed as "organic aggregates maintaining their integrity and continuity in time in a variable and fluctuating environment. From this point of view, the persistence of the entire system, i.e., resilience, is the variable of interest, and not the constancy of its functions."[413] The ability of humans to function so effectively may be a result of the resilience we built up because of our continuing need to cope with environmental change.[414]

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409. Holling, *supra* note 139, at 481.

410. O.T. Solbrig, *Plant Traits and Adaptive Strategies: Their Role in Ecosystem Function*, *in* BIODIVERSITY AND ECOSYSTEM FUNCTION 97, 110-11. (Ernst-Detlef Schulze & Harold A. Mooney eds., 1994)

411. *Id.* at 111.

412. Michael Loreau, *Biodiversity and Ecosystem Functioning: Recent Theoretical Advances*, 91 OIKOS 3, 13 (2000). *See also* Charles Perrings, *Biodiversity Conservation as Insurance*, *in* THE ECONOMICS AND ECOLOGY OF BIODIVERSITY DECLINE: THE FORCES DRIVING GLOBAL CHANGE 69 (Timothy M. Swanson ed., 1995).

413. Solbrig, *supra* note 410, at 108.

414. The Smithsonian Institution's Rick Potts has elaborated on the theory of disturbance-generated resilience to suggest that the dominance of *Homo sapiens* is a result of our ability to react to nature's perturbations:

> Our lineage arose as large, periodic fluctuations governed the conditions of survival. The effects were felt by the hominids and experienced by the biotic world at large. The distinguishing qualities of human culture emerged later, attached to extreme, repetitive shifts in climate and biota. The power to alter our surroundings grew stronger as a way of

Resource managers who use too short a time frame often fail to acknowledge that such disturbances as fire, flood, and disease are part of natural ecological cycles.[415] Authors in the relatively new field of "ecological economics" are devoted to the study of "coevolutionary development of human beings and the natural world"[416] and have addressed the need to include information about both economic and ecological cycles in economic decision-making processes.[417] Allen and Hoekstra point out that if viewed at an appropriate time scale "almost all processes that at first appear to be a linear progression will emerge as cyclical . . . . Individual fires are directional and have a before and after; nevertheless, fires return in a fire cycle."[418]

Resource managers increasingly recognize that it would be short-sighted to treat each disturbance as a one-time event and focus on it exclusively.[419] Indiscriminate use of techniques such as insecticides, fire suppression and fish hatcheries may slowly reduce heterogeneity in favor of uniformity, which then enlarges the area at risk. For example, if there are fewer breaks in the forest, disease

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> moderating erratic environmental change. The results were intimate and consistent with nature's own periodic facelift. This outlook on our evolution differs sharply from the tenets about nature and humanness lodged in Western thought.

RICK POTTS, HUMANITY'S DESCENT: THE CONSEQUENCES OF ECOLOGICAL INSTABILITY 44 (1996). *See also* STEVE JONES, THE LANGUAGE OF THE GENES 199-206 (1993) (noting that humans went through dramatic environmental change). Mahdav Gadgil argues that this long history of environmental change has programmed people to be attracted to conserving artifacts along with nature. Mahdav Gadgil, *Of Life and Artifacts, in* THE BIOPHILIA HYPOTHESIS 365, 366-67 (Stephen R. Kellert & Edward O. Wilson eds., 1993).

415. *See* De Leo & Levin, *supra* note 406, (noting that attempts by resource managers to attain stability have led to a loss of resiliency that has produced worse crises than in unmanaged ecosystems).

416. THOMAS PRUGH ET AL., NATURAL CAPITAL AND HUMAN ECONOMIC SURVIVAL 21 (1995).

417. Kenneth Arrow et al., *Economic Growth, Carrying Capacity, and the Environment*, 268 SCI. 520 (1995).

418. T.F.H. ALLEN & THOMAS W. HOEKSTRA, TOWARD A UNIFIED ECOLOGY 20 (1992).

419.
> Conventional resource management is predisposed to block out disturbance, which may be "efficient" in a limited sense in the short term. But since disturbance is endogenous to the cyclic processes of ecosystem renewal, conventional resource management tends to increase the potential for larger-scale disturbances and even less predictable and less manageable feedbacks from the environment. These feedbacks, or surprises, can have devastating effects on ecosystems and on societies that depend on the resources and services that ecosystems generate. As resilience or the buffering capacity of the system gradually declines, flexibility is lost, and the linked social-ecological system becomes more vulnerable to surprise and crisis.

Carl Folke et al., *Ecological Practices and Social Mechanisms for Building Resilience and Sustainability, in* LINKING SOCIAL AND ECOLOGICAL SYSTEMS: MANAGEMENT PRACTICES AND SOCIAL MECHANISMS FOR BUILDING RESILIENCE 414, 415-16 (Fikret Berkes & Carl Folke eds., 1998) (citations omitted).

may spread more easily. In grasslands, exotics that outcompete drought-resistant grasses may spread more widely in homogeneous environments. In fisheries, wild species may be driven out by increased non-native hatchery introduced fish, leaving the industry dependent on hatcheries whose productivity declines with time.[420]

Examination of disturbance regimes over long time scales has led to attempts to discern patterns of disturbance that would assist the forecast of future disturbance. One result of this research is the exploration of the idea that disturbance regimes may generally follow a pattern of long periods of stability interrupted by short bursts of change.[421] Some biologists have commented on the fact that the new emphasis on dramatic ecological change is analogous to current evolutionary biology theorists rejecting the traditional notion that evolution is necessarily a continuous process of gradual change.[422] Using the seminal paper of Gould and Eldredge as a basis, many evolutionary biologists believe that evolution is characterized by "punctuated equilibrium," in which long periods of relatively minor changes are periodically interrupted by periods in which change takes place rapidly in response to some form of change in environmental conditions.[423] Although gradual change also occurs, it often seems to be simply "a sort of oscillation within a spectrum of possible states."[424] Ecologists recognize the need for

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420. C.S. Holling, *New Science and New Investments for a Sustainable Biosphere*, *in* INVESTING IN NATURAL CAPITAL: THE ECOLOGICAL ECONOMICS APPROACH TO SUSTAINABILITY 57, 67-68 (AnnMari Jansson et al. eds., 1994). Although catastrophic disturbance may be the most important variable affecting resource management, it is also the hardest one to predict successfully. Craig L. Shafer, *Terrestrial Nature Reserve Design at the Urban/Rural Interface*, *in* CONSERVATION IN HIGHLY FRAGMENTED LANDSCAPES 345, 351 (Mark W. Schwartz ed., 1997).

421. Punctuated equilibrium results in increased speciation because the emptying of niches after severe disturbance causes rapidly increased birth rates, and speciation correlates with birth rate; i.e., a certain, constant, small percentage of births will result in new species. HUBBELL, *supra* note 39, at 236-37.

422. PER BAK, HOW NATURE WORKS: THE SCIENCE OF SELF-ORGANIZED CRITICALITY 117-118, 141-142, 156-159 (1996). *See* PETER J. BOWLER, EVOLUTION: THE HISTORY OF AN IDEA 336-341 (rev. ed. 1989).

423. Extended periods of little change in ecological systems are sometimes referred to as "coordinated stasis," and there is considerable debate over whether this results simply from the fitness adjustment of the individual species or from organization at the community level. Richard B. Aronson & Roy E. Plotnick, *Scale-Independent Interpretations of Macroevolutionary Dynamics*, *in* BIODIVERSITY DYNAMICS: TURNOVER OF POPULATIONS, TAXA AND COMMUNITIES 430 (Michael L. McKinney & James A. Drake eds., 1998). For an analysis of the spread of the concept of punctuated equilibrium to other fields, see Connie J.G. Gersick, *Revolutionary Change Theories: A Multilevel Exploration of the Punctuated Equilibrium Paradigm*, 16 ACAD. MGMT. REV. 10 (1991). The original paper is Niles Eldredge & Stephen Jay Gould, *Punctuated Equilibria: An Alternative to Phyletic Gradualism*, *in* MODELS IN PALEOBIOLOGY 82 (Thomas J.M. Schopf ed., 1972). *See also* Stephen Jay Gould & Niles Eldredge, *Punctuated Equilibrium Comes of Age*, 366 NATURE 223 (1993).

424. NILES ELDREDGE, TIME FRAMES: THE EVOLUTION OF PUNCTUATED EQUILIBRIA 145

more research into the impacts of cyclical landscape phenomena, such as the oscillation of warm and cold waters in the Pacific Ocean.[425] Similarly, today's ecologists are beginning to recognize that ecological changes "tend not to proceed in smooth and even steps but rather in fits and starts,"[426] and that the analysis of those fits and starts may prove most productive.[427] Ecologists' growing ability to analyze ecological information over long time frames allows them to use the study of disturbance with increasingly important effect in the protection of biodiversity.[428]

Complexity theorists say that some current studies of ecological disturbance illustrate more general theories of complexity.[429] Complexity researchers seek to find common principles that govern the evolution of all complex adaptive systems.[430] Whether or not scientists will discover overall patterns of complexity that can be used to forecast and manage disturbance, ecologists at least know that even if some disturbance may be desirable, it does not follow that all disturbance is desirable. Finding the boundary between "good" and "bad" disturbance is one of the most challenging issues of today's ecology.[431]

(1985). Holling argues that ecological systems don't have a single equilibrium; they have multiple equilibria that define functionally different states, and non-linear movement between these states is a natural part of maintaining structure and diversity. Bryan G. Norton, *A Scalar Approach to Ecological Constraints, in* ENGINEERING WITHIN ECOLOGICAL CONSTRAINTS 45, 50-51 (Peter C. Schulze ed., 1996) (suggesting that "Holling's ideas . . . may usher in a new era in thinking about environmental management, an era that is more concerned with processes, functions, and thresholds, and less concerned with system behavior near equilibrium."). *See also* JAMES H. BROWN, MACROECOLOGY 192-93 (1995) (discussing the idea that periods of apparent stasis may reflect species shifting their geographic environment in response to gradual changes in climate or other environmental factors).

425. John N. Thompson et al., *Frontiers of Ecology*, 51 BIOSCIENCE 15 (2001).

426. FIKRET BERKES, SACRED ECOLOGY: TRADITIONAL ECOLOGICAL KNOWLEDGE AND RESOURCE MANAGEMENT 160 (1999). *See also* CARL WALTERS, ADAPTIVE MANAGEMENT OF RENEWABLE RESOURCES 32-34 (1986) (discussing rhythms of crises and opportunities).

427. For example, a recent study ambitiously attempts to recreate the paths of all of the hurricanes that have impacted New England since 1620 and to trace the history of their ecological effects. Emery R. Boose et al., *Landscape and Regional Impacts of Hurricanes in New England*, 71 ECOLOGICAL MONOGRAPHS 27 (2001).

428. Frank Davis & Max Moritz, *Mechanisms of Disturbance*, *in* 2 ENCYCLOPEDIA OF BIODIVERSITY 153, 155 (Simon A. Levin ed., 2001).

429. *See, e.g.*, J.B. Ruhl, *supra* note 403. *See also* LEVIN, *supra* note 91.

430. For a useful introduction to complexity theory, see ROGER LEWIN, COMPLEXITY: LIFE AT THE EDGE OF CHAOS (1992). For a quick summary, see Walter Fontana & Susan Ballati, *Complexity: Why the Sudden Fuss?*, 4 COMPLEXITY #3, 14 (1999).

431. For an interesting philosophical discussion of the "randomness" of environmental change and its impact on human behavior, see Mark A. Michael, *How to Interfere with Nature*, 23 ENVTL. ETHICS 135 (2001).

D. Metastability May Exist Without Equilibrium

With the growing agreement of ecologists that a permanent state of equilibrium is not the normal state of nature, some observers have lamented the prospect of a natural world without meaningful Platonic ideals.[432] But others, including many ecologists, see the prospect of relatively stable states of constant motion.[433] Scientists coined the term "metastability" to describe a condition in which irregular disturbances at one scale enable an ecological system to find something akin to stability at a higher level.[434]

1. Can Regular Patterns of Change Create Long-Term Stability?

Ecological metastability, ecologist Jianguo Wu suggests, it is "possibly the closest technical equivalent to 'balance of nature.'"[435] It is a combination of instabilities that create stability.[436] "As long as the landscape system oscillates around a central position, it is in a metastable equilibrium."[437]

The observation of nature at large scales of space and time typically results in the recognition of patterns undetected at closer range.[438] Over short periods of time in small areas, species diversity may appear to vary greatly, while at continental and evolutionary scales, species diversity may appear to be in equilibrium.[439] Similarly, stocks of biomass and nutrients vary

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432. *See, e.g.*, Godlovitch, *supra* note 339.

433. *See, e.g.*, Peggy L. Fiedler et al., *The Paradigm Shift in Ecology and its Implications for Conservation, in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 83, 85-86 (Steward T.A. Pickett et al. eds, 1997).

434. Wu & Loucks, *supra* note 129, at 439.

435. *Id.* at 459. *See also* Peter Chesson, *Metapopulations, in* 4 ENCYCLOPEDIA OF BIODIVERSITY 161, 175 (Simon A. Levin ed., 2001) (noting that equilibrium occurs at large spatial and temporal scales); Ahl & Allen, *supra* note 124, at 169-71 (noting that ecological systems can evolve to a higher level of organization when response to disturbance has "become incorporated into the system"). The hierarchy theory of ecology rests on an assumption that metastable subsystems exist. "The guild, as a functional unit, is more constant, stable and enduring than any of the individual species that comprise it." R.V. O'NEILL, ET AL., A HIERARCHICAL CONCEPT OF ECOSYSTEMS 121 (1986). Other ecologists have used the term "quasi-equilibrium landscape" to represent a similar concept. H.H. Shugart, *Equilibrium Versus Non-equilibrium Landscapes, in* ISSUES IN LANDSCAPE ECOLOGY 18, 19 (John A. Wiens & Michael R. Moss eds., 1999).

436. "Metastability . . . is not an intermediate condition between instability and stability. Rather, it is a combination of the two properties." FORMAN & GODRON, *supra* note 236, at 436. *See, e.g.*, Alan A. Berryman et al., *Metastability of Forest Systems Infested by Bark Beetles*, 26 RESEARCHES ON POPULATION ECOLOGY 13 (1984).

437. FORMAN & GODRON, *supra* note 236, at 431.

438. BRIAN A. MAURER, UNTANGLING ECOLOGICAL COMPLEXITY: THE MACROSCOPIC PERSPECTIVE 140-41 (1999).

439. Michael L. McKinney, *Biodiversity Dynamics: Niche Preemption and Saturation in Diversity Equilibria, in* BIODIVERSITY DYNAMICS: TURNOVER OF POPULATIONS, TAXA, AND

greatly on small scales because vegetation changes frequently, but may appear roughly constant when observed at large scales.[440]

Is the hope to find metastability in the combination of multiple instabilities just wishful thinking?[441] Is there reason to hope that a metastable environment will generate the same aesthetic appeal and emotional excitement that humans have obtained from thinking of the natural world as stable? Is ecologist Daniel Botkin correct that "the beauty in the dynamics of nature can replace the beauty of the idea of stasis?"[442]

Metastability would be possible only if the changes we make to the environment are not unidirectional.[443] Environmental historian Donald Worster emphasizes the need to distinguish between cyclical change and linear change.[444] Moderate swings back and forth in climate, land cover, species dominance, and other ecological conditions could presumably be tolerated in a metastable world,[445] but if changes are only in one direction we are going to need to operate in a world of continuous, unpredictable change.[446]

COMMUNITIES 1, 3 (Michael L. McKinney & James A. Drake eds., 1998); Mooney et al., *supra* note 213, at 313 (noting that shifting patches of landscape may reach a steady state).

440. Peter M. Vitousek, *Community Turnover and Ecosystem Nutrient Dynamics*, *in* THE ECOLOGY OF NATURAL DISTURBANCE AND PATCH DYNAMICS 325, 333 (Steward T.A. Pickett & P.S. White eds., 1985).

441. Complexity theorists are also searching for evidence of metastability in ecological systems. *See* KUNIHIKO KANEKO & ICHIRO TSUDA, COMPLEX SYSTEMS: CHAOS AND BEYOND 179-190 (2000) (arguing that "homeochaos" protects diversity against disturbance by avoiding violent change in population dynamics).

442. DANIEL B. BOTKIN, NO MAN'S GARDEN: THOREAU AND A NEW VISION FOR CIVILIZATION AND NATURE 239 (2001).

443. V. Ingegnoli, *Human Influences in Landscape Change: Thresholds of Metastability*, *in* TERRESTRIAL AND AQUATIC ECOSYSTEMS: PERTURBATION AND RECOVERY 303 (Oscar Ravera ed., 1991) (suggesting outline of model for threshold of metastability). For example, it has been estimated that the steady, gradual urbanization of South Florida has caused climate changes resulting in a significant decrease in summer rainfall. R.A. Pielke, Sr. et al., *The Influence of Anthropogenic Landscape Changes on Weather in South Florida*, 127 MONTHLY WEATHER REV. 1663 (1999).

444. Donald Worster, *Nature and the Disorder of History*, *in* REINVENTING NATURE?: RESPONSES TO POSTMODERN DECONSTRUCTION 65, 81-82 (Michael E. Soulé & Gary Lease eds., 1995).

445. "The biosphere is always changing in response to cycles." WILLIAM H. SCHLESINGER, BIOGEOCHEMISTRY: AN ANALYSIS OF GLOBAL CHANGE 8 (2d ed. 1997). Holling refers to the phenomenon of "[a]brupt shifts among a multiplicity of very different stable domains" in such areas as lakes, marine fisheries, wetlands, forests and rangelands. C.S. HOLLING ET AL., FINAL REPORT OF THE PROJECT: RESILIENCE OF ECOSYSTEMS, ECONOMIC SYSTEMS AND INSTITUTIONS, April 30, 2000, at p. 4. *See also* Johan van de Koppel et al., *Do Alternate Stable States Occur in Natural Ecosystems? Evidence from a Tidal Flat*, 82 ECOLOGY 3449 (2001) (functional relationships among erosion, silt content, and diatom growth lead to alternate stable states in tidal flat ecological systems).

446. See *infra* text accompanying notes 718-754.

2. Today's Rate of Environmental Change is Unprecedented

Many scientists fear that the earth's ecological systems are now experiencing change at a rate that previously occurred only during global catastrophes,[447] such as the one that characterized the Cretaceous/Tertiary boundary,[448] and that some of today's changes, such as extreme pollution and fragmentation of the land by humans, have no historical or prehistorical precedent.[449] The availability of large-scale ecological data makes it possible to visualize the ways that land use changes have gradually pushed back the boundaries of natural areas.[450]

History provides many other examples of human-caused disturbance that caused the collapse of ecological systems, many of which were not understood until it was too late.[451] Loss of resiliency has led to the collapse of fisheries, the desertification of arable land, the eutrophication of previously clear lakes, and other types of ecological collapse.[452] Many ecologists believe that there is an urgent need to identify and agree upon measurable criteria for limiting the nature and extent of ecological change.[453] Advances in

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447. *See, e.g.*, PETER WARD, THE END OF EVOLUTION: A JOURNEY IN SEARCH OF CLUES TO THE THIRD MASS EXTINCTION FACING PLANET EARTH (1994).

448. John Harte, *Land Use, Biodiversity, and Ecosystem Integrity: The Challenge of Preserving Earth's Life Support System*, 27 ECOLOGY L.Q. 929, 961-63 (2001). *See* David M. Raup, *Extinction in the Geologic Past*, *in* ORIGINS AND EXTINCTIONS 109 (Donald E. Osterbrock & Peter H. Raven eds., 1988).

449. Christensen et al., *supra* note 134, at 675-76 (1996).

450. For examples, see the website of the National Aeronautic and Space Agency *available at* http://gcmd.gsfc.nasa.gov (last visited Jan. 4, 2002). A list of other sources of such data are *available at* http://www.sciencemag.org/feature/data/ecology2001.shtml (last visited Jan. 4, 2002).

451. For instance the demand for fuelwood can be satisfied by a forest even when the recovery of trees is no longer possible but the subsequent deforestation will be visible some years after the decline start[s] and will probably be discovered too late for countermeasures. The same has occurred in most European uplands over the last fifty years. During this time, the emigration of a considerable part of the population from hilly and mountainous regions occurred, the long term consequence of which was agricultural abandonment. This effect was under-estimated because it was buffered by the older generations of farmers who remained in the countryside, and by huge agricultural subsidies.

ALMO FARINA, LANDSCAPE ECOLOGY IN ACTION 163 (2000). Europeans, having inhabited their continent longer than Americans, may be more conscious of the extent to which human activities can cause ecological collapse. *See* Z. Naveh, *Mediterranean Uplands as Anthropogenic Perturbation-Dependent Systems and Their Dynamic Conservation Management*, *in* TERRESTRIAL AND AQUATIC ECOSYSTEMS: PERTURBATION AND RECOVERY 545, 548-50 (Oscar Ravera ed., 1991) (describing the rapid decline of Mediterranean habitats).

452. Simon A. Levin, *Multiple Scales and the Maintenance of Biodiversity*, 3 ECOSYSTEMS 498, 502 (2000).

453. The development of such criteria may require more baseline data gathering. *See* H. JOHN HEINZ III CENTER FOR SCIENCE, ECONOMICS AND THE ENVIRONMENT, DESIGNING A

information technology have made the prospect of resolving these issues seem more optimistic today than even a decade ago.[454]

But to resolve these problems caused by the cumulative effects of unidirectional, incremental change, society must undertake measures to reverse trends that are well entrenched[455] and involve the cumulative effect of millions of individual activities, the impact of any one of which may seem innocuous.[456] Two trends that provide examples of gradual, unidirectional change caused by millions of individual human actions are the increased emission of greenhouse gases and the increase in nitrogen deposition in coastal waters.

i. Unidirectional Climate Change

A prominent example of unidirectional change is the response of ecological systems to climate change, a global scale phenomenon that also demands study at extensive temporal scales.[457] Each year in the 1990s ranked among the warmest fifteen years of the Twentieth Century,[458] and the year 2001 was the second warmest year in history.[459]

REPORT ON THE STATE OF THE NATION'S ECOSYSTEMS (1999). For a recent example of baseline data gathering, see Daily at al., *supra* note 275, at 1.

454. Daniel C. Esty & Marian R. Chertow, *Thinking Ecologically: An Introduction, in* THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY 1, 5 (Marian R. Chertow & Daniel C. Esty eds., 1997).

455. The human modifications of the environment that affect plants include "levels of soil nitrogen, phosphorus, calcium and pH, atmospheric CO_2, herbivore, pathogen, and predator densities, disturbance regimes, and climates." David Tilman & Clarence Lehman, *Human-Caused Environmental Change: Impacts on Plant Diversity and Evolution*, 98 PROC. NAT'L ACAD. SCI. USA 5433, 5433 (2001).

456. *See* James Salzman, *Beyond the Smokestack: Environmental Protection in the Service Economy*, 47 UCLA L. REV. 411, 454-71 (1999) (discussing cumulative impact of small service operations).

457. NAT'L RESEARCH COUNCIL, *supra* note 7, at 27-31. Changes in atmospheric carbon dioxide can be evaluated in the context of 220,000 year record obtained from bubbles in polar ice caps. SCHLESINGER, *supra* note 445, at 11.

458. NATIONAL ASSESSMENT SYNTHESIS TEAM, UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE CHANGE IMPACTS ON THE UNITED STATES: THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE 12 (2001), *available at* http://www.usgcrp.gov/usgcrp/nacc/default.htm (last visited May 28, 2002).

459. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL CLIMATIC DATA CENTER, CLIMATE OF 2001 - ANNUAL REVIEW, *available at* http://lwf.ncdc.noaa.ov/oa/climate/research/2001/ann/ann.html (last updated Jan. 16, 2002).

Unusual weather events of the 1990s [460] brought increasing attention to the need to distinguish historic cycles from unidirectional changes caused by human activity.[461] Current concerns about climate change[462] underscore the need to view ecological phenomena as fluid.[463] Climatologists forecast that many parts of the world will show significant temperature increases over the next century.[464] A committee of the National Academy of Sciences of the United States, in its review of the work of the International Panel on Climate Change, agreed with the Panel's conclusion that the best existing models suggest that temperatures would increase from 2.5 to 10.4 degrees Fahrenheit by the end of the century and that the "predicted warming is larger over higher latitudes than over low latitudes, especially during winter and spring, and larger over land than over sea."[465] The following table illustrates the potential effect of such changes by showing how the

460. Of particular relevance is the exceptionally strong El Niño event of 1997-1998. *See generally* EL NIÑO 1997-1998: THE CLIMATE EVENT OF THE CENTURY (Stanley A. Chagnon ed., 2000). Historical research indicates that El Niño is a cyclical phenomenon. Periodically, for reasons that have yet to be fully explained, the trade winds disappear and an El Niño condition develops. The air pressure pattern reverses itself, and because there are no trade winds to move the air from the east to the west, the air stays in place and grows warmer. It reaches the point of deep convection, which is the point at which steamy surface air bursts into the upper atmosphere. Water in the upper atmosphere condenses and falls on the west coast of the Americas as torrential rain. This leads to many other changes. While the Americas experience an increase in rainfall, Australia, Indonesia, and India often experience drought. In North America, the jet streams shift, and the polar jet stream generally stays over Canada, resulting in less cool air over the U.S. Upper level tropical winds also reverse themselves, which takes the tops off cyclones forming in the mid-Atlantic. The number of hurricanes that hit the U.S. tends to be cut in half. ROGER G. BARRY & RICHARD J. CHORLEY, ATMOSPHERE, WEATHER AND CLIMATE 276-82 (7th ed. 1998).

461. Paleoecologists study the impact of weather cycles on organisms at geological time scales. *See* Mats Dynesius & Roland Jansson, *Evolutionary Consequences of Changes in Species' Geographical Distributions Driven by Milankovitch Climate Oscillations*, 97 PROC. NAT'L ACAD. SCI. USA 9115 (2000). *See generally* SCHLESINGER, *supra* note 445.

462. I have summarized my analysis of the climate change issue in FRED BOSSELMAN ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT 1200, 1200-41 (2000).

463. *See, e.g.*, Robert T. Paine et al., *Compounded Perturbations Yield Ecological Surprises*, 1 ECOSYSTEMS 535, 537-38 (1998) (stating that climate change increases impact of environmental disturbance); Turner & Dale, *supra* note 342, at 758 (1997) ("Understanding the response of disturbance regimes characterized by large, infrequent events to climatic change remains an important challenge.").

464. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SUMMARY FOR POLICYMAKERS: A REPORT OF WORKING GROUP I OF THE IPCC (2001), *at* www.usgcrp.gov/ipcc.htm (updated Aug. 3, 2000); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: THE SCIENTIFIC BASIS – SUMMARY FOR POLICYMAKERS, A REPORT OF WORKING GROUP I OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2001), *at* www. sgcrp.gov/usgcrp/assessments. tmipcc/htm (updated Feb 5, 2002).

465. COMMITTEE ON THE SCIENCE OF CLIMATE CHANGE, DIVISION OF EARTH AND LIFE STUDIES, NATIONAL RESEARCH COUNCIL, CLIMATE CHANGE SCIENCE: AN ANALYSIS OF SOME KEY QUESTIONS 4 (2001). For a general overview of climate change science, see FRANCES DRAKE, GLOBAL WARMING: THE SCIENCE OF CLIMATE CHANGE (2000).

average temperature in certain cities might come to resemble the current average temperature in other, warmer cities:

CITIES WITH ANNUAL MEAN TEMPERATURES ILLUSTRATIVE OF POTENTIAL INCREASED WARMING[466]

Current city	3-4 degree F. increase	6-7 degree increase	9-10 degree F. increase
Winnipeg	Quebec	Montreal	Toronto
Bismarck	Sioux Falls	Toledo	Columbus OH
Burlington VT	Youngstown	Boston	Wilmington DE
Buffalo	Pittsburgh	Philadelphia	Paducah
Denver	Topeka	Amarillo	Charlotte
Chicago	Indianapolis	Asheville	Washington DC
Portland OR	San Francisco	Tulsa	Fresno
New York City	Washington DC	Birmingham	Jackson MS
St. Louis	Oklahoma City	Columbia SC	Shreveport
San Francisco	Sacramento	Fresno	Waco
Nashville	Wichita Falls	Dallas	Austin
Atlanta	Columbus GA	Jacksonville	Daytona Beach
El Paso	Tallahassee	Galveston	Tampa
Los Angeles	Galveston	Orlando	Miami
New Orleans	Corpus Christi	West Palm Beach	Honolulu
Austin	Phoenix	Kahului	Key West

It will be particularly important to try to predict the impact of this warming on ecological systems.[467] Studies of the impact of

466. Annual mean temperatures for United States cities taken from NATIONAL CLIMATIC DATA CENTER, COMPARATIVE CLIMATIC DATA FOR THE UNITED STATES THROUGH 1999 95-102 (2000); Canadian data taken from GILBERT SCHWARTZ, THE CLIMATE ADVISOR 253-90 (1977); table compiled by author.

467. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, WORKING GROUP II, CLIMATE

climate change on animal species are already beginning to show significant geographical movements of animals that appear to be the result of changes in climate.[468] For example, amphibians in Costa Rican cloud forests have significantly declined in the face of warmer and drier conditions.[469] A study of thirty-four European butterfly species found that their ranges had shifted to the north from 35 to 240 kilometers.[470]

The impact of climate change has been most notable in the northern part of the northern hemisphere. Rapid temperature increases in the Arctic regions[471] have had significant impacts on the species there[472] and models anticipate even greater future temperature increases[473] and ecological change.[474]

CHANGE 2001: IMPACTS, ADAPTATION AND VULNERABILITY, *at* http://usgcrp.gov/usgcrp/assessments.htm (updated Feb. 5, 2002).

468. *See, e.g.*, Jeremy T. Kerr, *Butterfly Species Richness Patterns in Canada: Energy, Heterogeneity, and the Potential Consequences of Climate Change*, 5 CONSERVATION ECOLOGY 1, 10, *available at* www.consecol.org/vol5/iss1/art10. For reviews of these studies, see John P. McCarty, *Ecological Consequences of Recent Climate Change*, 15 CONSERVATION BIOLOGY 320 (2001); Josep Peñuelas & Iolanda Filella, *Responses to a Warming World*, 294 SCIENCE 793 (2001).

469. J. Alan Pounds et al., *Biological Response to Climate Change on a Tropical Mountain*, 398 NATURE 611 (1999). South African ecologists are also worried that warmer and drier conditions may have massive impact on the highly diverse fynbos region in the Cape Province. W.J. Bond, *Functional Types for Predicting Changes in Biodiversity: A Case Study in Cape Fynbos*, *in* PLANT FUNCTIONAL TYPES: THEIR RELEVANCE TO ECOSYSTEM PROPERTIES AND GLOBAL CHANGE 174, 188 (T.M. Smith et al. eds., 1997).

470. Bernice Wuethrich, *How Climate Change Alters the Rhythms of the Wild*, 287 SCIENCE 793, 795 (2000). For an analysis of the impact of climate change on the mosquitoes that carry malaria, see S.I. Hay et al., *Climate Change and the Resurgence of Malaria in the East African Highlands*, 415 NATURE 905 (2002).

471. CLIMATE CHANGE IMPACTS ON THE UNITED STATES, *supra* note 458, at 287. (noting that Alaska's climate has warmed about 4 degrees Fahrenheit since the 1950s - part of a larger Arctic trend); For an interesting study of warming trends based on the results of an Alaskan ice break-up contest that has been held since 1917, see Raphael Sagarin & Florenza Micheli, *Climate Change in Nontraditional Data Sets*, 294 SCI. 811 (2001).

472. Kerr, *supra* note 468, at 10 (noting that many butterfly species throughout Canada appear to have expanded their range northward); C.D. Keeling et al., *Increased Activity of Northern Vegetation Inferred from Atmospheric Co_2 Measurements*, 382 NATURE 146 (1996) (pointing out the longer growing season for Arctic plants); Cynthia T. Tynan et al., *Endangered Right Whales on the Southeastern Bering Sea Shelf*, 294 SCI. 1894 (2001) (noting that right whales are at risk from warming waters). *See also* William Stolzenburg, *Nature Feels the Heat: As Climate Goes Awry, Wildlife Goes Away*, 51 NATURE CONSERVANCY 12, 17-18 (2001), *available at* http://nature.org/aboutus/magazine/2001/sepoct/work/art4735.html (discussing how the Nature Conservancy is trying to react to the impact of warming temperatures on their northern reserves); Darcy Frey, *George Divoky's Planet*, N.Y. TIMES MAG., Jan. 6, 2002, at 24 (discussing Divoky's study of how birds in the Beaufort Sea have reacted to warming conditions).

473. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: SYNTHESIS REPORT– Summary for Policymakers *available at* http://www.usgcrp.ov/usgcrp/ipcc.htm#SynthesisRrport (updated Feb. 5, 2002) (noting that glaciers are likely to continue widespread retreat, and that Northern Hemisphere snow cover, permafrost, and sea-ice extent are projected to decrease further).

474. T. Scott Rupp et al., *Response of Subarctic Vegetation to Transient Climatic Change*

Plant species will also be significantly affected by climate change.[475] Increased levels of carbon dioxide accelerate plant growth in laboratory studies,[476] but many botanists believe that any stimulative effects will be offset by declines in soil nutrient availability.[477] Moreover, the plants that could readily adapt to the new climate conditions may be far away and lack good dispersal capability.[478] And although some scientists hope that higher carbon dioxide levels will increase the ability of forests to store carbon, recent studies cast doubt on the extent to which this will occur.[479]

Not all climate change is unidirectional. The ability to study the world's climate at large temporal and spatial scales has led to a

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on the Seward Peninsula in Northwest Alaska, 6 GLOBAL CHANGE BIOLOGY 541, 552-53 (2000), *available at* http://www.blackwell-synergy.com/servlet/useragent?func=callWizard&wizardKey=salesAgent: 1013562618390&action=show (showing that tundra would be replaced by forest with frequent fires). The World Wildlife Fund predicts that as much as 70% of the natural habitat of the Arctic could be lost by the end of the century. Sarah Lyall, *A Global Warming Report Predicts Doom for Many Species*, N.Y. TIMES, Sept. 1, 2000, at A3. *See also* Walter C. Oechel et al., *Effects of CO_2 and Climate Change on Arctic Ecosystems*, *in* ECOLOGY OF ARCTIC ENVIRONMENTS 255 (Sarah J. Woodin & Mick Marquiss eds., 1997). The Arctic is also the area most susceptible to pollution from many organic pollutants that vaporize in warmer climates but condense when they encounter colder temperatures. Chemicals such as DDT, PCBs, chlordane, and dioxin flow throughout the world's atmosphere, reaching the surface primarily in the polar regions. Concentrations of these substances build up to dangerous levels in the fat tissues of Arctic animals. Indigenous peoples of the region tend to eat substantial amounts of animal fats, and this has produced significant concerns about long term effects on human health in the Arctic regions. One example is a monitoring program sponsored by a number of northern countries, *available at* http://www.amap.no (last visited Jan. 5, 2002). A convention signed in 2001 establishes procedures for the international regulation of these substances. Peter L. Lallas, *The Stockholm Convention on Persistent Organic Pollutants*, 95 AM. J. INT'L L. 692 (2001).

475. Tilman & Lehman, *supra* note 455.

476. CHARLES J. KREBS, ECOLOGY: THE EXPERIMENTAL ANALYSIS OF DISTRIBUTION AND ABUNDANCE 681-83 (4th ed. 1994).

477. Increased CO_2 resulting from climate change will cause little increased growth stimulation except where soil nitrogen is abundant, but even then the increase "will be constrained by declines in the nutrient availability due to the increased C/N ratio of plant litter, resulting in greater nitrogen immobilization by soil microbes." S.E. Hobbie et al., *Resource Supply and Disturbance as Controls over Present and Future Plant Diversity*, *in* BIODIVERSITY AND ECOSYSTEM FUNCTION 385 (Ernst-Detlef Schulze & Harold A. Mooney eds., 1994). One recent study suggests that areas with a rich diversity of species will more effectively store the carbon generated by faster plant growth than will species-poor areas, such as agricultural monocultures. Peter B. Reich et al., *Plant Diversity Enhances Ecosystem Responses to Elevated CO_2 and Nitrogen Deposition*, 410 NATURE 809 (2001).

478. D. Tilman, *Community Diversity and Succession: The Roles of Competition, Dispersal, and Habitat Modification*, *in* BIODIVERSITY AND ECOSYSTEM FUNCTION 327, 339 (Ernst-Detlef Schulze & Harold A. Mooney eds., 1994); David S. Woodruff, *Declines of Biomes and Biotas and the Future of Evolution*, 98 PROC. NAT'L ACAD. SCI. USA 5471, 5472 (2001) (noting that the ability of plants to adapt is reduced by creation of inhospitable matrix between habitat patches).

479. *See, e.g.*, William H. Schlesinger & John Lichter, *Limited Carbon Storage in Soil and Litter of Experimental Forest Plots Under Increased Atmospheric CO_2*, 411 NATURE 466 (2001); Ram Oren et al., *Soil Fertility Limits Carbon Sequestration by Forest Ecosystems in a CO_2-enriched Atmosphere*, 411 NATURE 469 (2001).

greater understanding of the cyclical nature of certain climatic patterns.[480] Much attention has been focused on the cycle of temperature change of the waters of the South Pacific known as the El Niño Southern Oscillation (ENSO).[481] A recent example is the El Niño of 1997-98, which dramatically altered weather patterns around the world, causing at least 2100 deaths and approximately $33 billion in property damage.[482] Numerous recent studies have examined the effects on the ENSO cycles on the plants and animals in the affected areas.[483] The ability to predict ENSO cycles remains elusive.[484]

Cycles of rainfall and drought are also seen as a natural part of ecological processes. Nowhere has this been more evident than in the Everglades, where ecologists and engineers are trying to protect ecological systems of staggering complexity. For example, the wood stork only nests in the Everglades when water levels are low. The snail kite only nests when water levels are high. Both species are threatened.[485]

Through large scale studies we may improve our ability to separate the impacts of cyclical climate change from the impacts of

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480. For a concise summary of climate change analysis, see BARRY & CHORLEY, *supra* note 460, at 42.

481. *See generally* EL NIÑO, *supra* note 460. The phenomenon of El Niño has captured the public attention only recently, although historians and archaeologists have been able to reconstruct evidence indicating that the phenomenon has long existed. Fishermen originally gave this weather phenomenon its name. A pool of hot water the size of Canada would appear off the west coast of the Americas around Christmastime, so the fishermen gave it the name El Niño for Christ Child. There are records of El Niño's effects on Peru as far back as 1525 and it is possible that the Incas knew of El Niño 13,000 years ago. However, the rest of the world only started paying attention to this climate cycle about twenty-five years ago. Curt Suplee, *El Niño/La Niña, Nature's Vicious Cycle*, 195 NAT'L GEOGRAPHIC, Mar. 1999, at 72.

482. Suplee, *supra* note 481, at 73.

483. *See, e.g.*, P.D. Plisnier et al., *Impact of ENSO on East African Ecosystems: A Multivariate Analysis Based on Climate and Remote Sensing Data*, 9 GLOBAL ECOLOGY & BIOGEOGRAPHY 481 (2000). A review of such studies is found in Milena Holmgren et al., *El Niño Effects on the Dynamics of Terrestrial Ecosystems*, 16 TRENDS IN ECOLOGY & EVOLUTION 89 (2001); Fabian M, Jaksic, *Ecological Effects of El Niño in Terrestrial Ecosystems of Western South America*, 24 ECOGRAPHY 241 (2001). Research into deep ocean currents may uncover further links between oceanic oscillations and climate. William K. Stevens, *Scientists Studying Deep Ocean Currents for Clues to Climates*, N.Y. TIMES, Nov. 9, 1999, at F5.

484. NAT'L RESEARCH COUNCIL, *supra* note 7, at 28.

485. Harris, *supra* note 172, at 319, 327. *See also* Simberloff, *supra* note 193, at 247, 251 (noting that the endangered Devil's Hole pupfish is favored by managers who keep water levels at heights that threaten a listed insect, the Ash meadows naucorid); Holly Doremus, *The Rhetoric and Reality of Nature Protection: Toward a New Discourse*, 57 WASH. & LEE L. REV. 11, 62 (2000) (noting that efforts to prevent invasive salt cedar from outcompeting native vegetation have been difficult because endangered bird has begun nesting in salt cedar).

long-range climate change[486] that are most worrisome to ecologists.[487] Because the effects of increased greenhouse gases are not likely to be cyclical,[488] the adaptations that plants have developed to cope with cyclical climatic variation may not be successful for adjusting to a steady change in one direction.[489] Ecologists are learning more about the impact of cyclical climate change, while faced with the probability of continuing unidirectional change toward warmer conditions that seem to defy easy metastable solutions.[490] Ecologists have begun to explore whether we can redesign our methods for protecting natural areas to cope with the changing climate. Flexible location of reserve boundaries is an appealing idea in principle, although it "has little precedent in the real world," but corridor systems that connect natural areas may become particularly important, because difficulty of dispersal to new habitats may be " the single biggest barrier to ecosystem adaptation in a changing climate."[491]

ii. Nitrogen Deposition

The lands and waters of the United States have been receiving increased quantities of nitrogen originating from human sources.[492] A group of leading ecologists led by Stanford's Peter Vitousek recently opined that: "[H]uman alterations of the nitrogen cycle have (1) approximately doubled the rate of nitrogen input into the

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486. *See* Thomas Kitzberger et al., *Inter-hemispheric Synchrony of Forest Fires and the El Niño-Southern Oscillation*, 10 GLOBAL ECOLOGY & BIOGEOGRAPHY 315 (2001); Lance Gunderson, *Resilience, Flexibility and Adaptive Management – Antidotes for Spurious Certitude*?, 3 CONSERVATION ECOLOGY 7, *available at* http://www.consecol.org/vol3/iss1/art7.

487. For a review of recent studies, see John P. McCarty, *Ecological Consequences of Recent Climate Change*, 15 CONSERVATION BIOLOGY 321 (2001).

488. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 473 (noting that stabilization of carbon dioxide in the atmosphere requires eventual reduction of global emissions to a small fraction of the current emission level). A series of case studies that examine the impact of climate change on ecological processes is found in WILDLIFE RESPONSES TO CLIMATE CHANGE: NORTH AMERICAN CASE STUDIES (Stephen H. Schneider & Terry l. Root eds., 2002).

489. Tilman, *supra* note 478, at 335-36.

490. *See, e.g.*, Tilman & Lehman, *supra* note 455.

491. Adam Markham & Jay Malcolm, *Biodiversity and Wildlife: Adaptation to Climate Change, in* ADAPTING TO CLIMATE CHANGE: AN INTERNATIONAL PERSPECTIVE 384, 392-93 (Joel B. Smith et al. eds., 1996). The Nature Conservancy has been studying ways of adapting its reserve system to climate change. Carol Goodstein, *A Sea Change: As the Planet Warms, The Nature Conservancy Searches for New Strategies*, 51 NATURE CONSERVANCY 22 (2001).

492. For a general description of the problems of managing nutrient loading of waters, see Clive A. David, *Managing the Invisible: Ecosystem Management and Macronutrient Cycling, in* ECOSYSTEM MANAGEMENT: APPLICATIONS FOR SUSTAINABLE FOREST AND WILDLIFE RESOURCES 94 (Mark S. Boyce & Alan Haney eds., 1997). Increased nitrogen loading impacts terrestrial ecological systems as well. *See generally* Tilman & Lehman, *supra* note 455, at 5436-38.

terrestrial nitrogen cycle, with the rates still increasing; . . . [and] (5) greatly increased the transfer of nitrogen through rivers to estuaries and coastal oceans."[493] This increased spread of nitrogen, primarily from the use of fertilizers and the burning of fossil fuels,[494] is harming ecological systems and threatening public health.[495]

The failure to undertake control of nonpoint sources of nitrogen and phosphorus has resulted in a steady increase in the nutrient loading of coastal waters.[496] As the National Research Council recently pointed out, the "results of excessive nutrient loadings are seen in reduced water clarity; nuisance algal blooms, including species with toxic forms . . ., and hypoxic (low oxygen) bottom waters." The "decomposition of dead algae in bottom waters consumes oxygen, leading to loss of habitat for fish and other forms of life."[497]

For example, leakage from injection of waste into wells in the Florida Keys has caused substantial eutrophication in and around Florida Bay.[498] In some cases, eutrophication results in algal blooms that can be harmful to human health.[499] The various

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493. Peter M. Vitousek et al., *Human Alteration of the Global Nitrogen Cycle: Sources and Consequences*, 7 ECOLOGICAL APPLICATIONS 737 (1997). *See also* Thomas E. Jordan & Donald E. Weller, *Human Contributions to Terrestrial Nitrogen Flux*, 46 BIOSCIENCE 655 (1996).

494. The nitrogen compounds released from the tall stacks of coal-burning power plants are a major source of acid rain. SCHLESINGER, *supra* note 445, at 387-88.

495. Jocelyn Kaiser, *The Other Global Pollutant: Nitrogen Proves Tough to Curb*, 294 SCI. 1268 (2001). The agricultural industry refers to this process as "nutrient enrichment." Oliver A. Houck, *Damage Control: A Field Guide to Important Euphemisms in Environmental Law*, 15 TUL. ENVTL. L.J. 129, 131 (2001).

496. *See* David Tilman, *The Greening of the Green Revolution*, 396 NATURE 211 (1998) (noting that conventional agriculture releases more nitrogen than alternative methods such as reduced tillage or manure application). For an analysis of the impact of nitrogen deposition on the Great Barrier Reef, see Miles Furnas & Alan Mitchell, *Runoff of Terrestrial Sediment and Nutrients into the Great Barrier Reef World Heritage Area*, *in* OCEANOGRAPHIC PROCESSES OF CORAL REEFS: PHYSICAL AND BIOLOGICAL LINKS IN THE GREAT BARRIER REEF 37, 42-46 (Eric Wolanski ed., 2001).

497. NAT'L RESEARCH COUNCIL, *supra* note 3, at 84. *See also* U.S. EPA, OFFICE OF WATER, NATIONAL WATER QUALITY INVENTORY: 1998 REPORT TO CONGRESS 130-32 (1998), available at www.epa.gov/305b/98report/toc.html. David Tilman, *Global Environmental Impacts of Agricultural Expansion: The Need for Sustainable and Efficient Practices*, 96 PROC. NAT'L ACAD. SCI. USA 5995 (1999) (noting that the impacts of nitrogen and phosphorus are well documented). Ironically, the increased deposit of nitrogen to the soil is believed to increase the ability of the terrestrial ecological systems to absorb carbon dioxide from the air. NAT'L RESEARCH COUNCIL, *supra* note 7, at 15.

498. Sydney T. Bacchus, *Knowledge of Groundwater Responses: A Critical Factor in Saving Florida's Threatened and Endangered Species*, 18 ENDANGERED SPECIES UPDATE 79, 81 (2001).

499. Lora E. Fleming et al., *Emerging Harmful Algal Blooms and Human Health: Pfiesteria and Related Organisms*, 27 TOXICOLOGIC PATHOLOGY 573 (1999). The increasing frequency and severity of algal blooms also impacts ecological systems. Bruce McKay & Kieran Mulvaney, *A Review of Marine Major Ecological Disturbances*, 18 ENDANGERED SPECIES

governmental agencies surrounding Chesapeake Bay have also been working for years to reduce the excessive nitrogen loadings,[500] but progress is slow.[501]

Where nitrogen loading is heavy, the oxygen content of water can be depleted ("hypoxia") or eliminated ("anoxia").[502] The largest area of environmental damage from increased nitrogen is an extensive area in the Gulf of Mexico where lower levels of the gulf waters are deprived of adequate oxygen every summer.[503] Between 1993 and 1998 the size of the so-called "dead zone" ranged from about 12,500 to about 18,000 square kilometers.[504]

The severity of hypoxic conditions, apparently varying with the extent of the Mississippi River discharge into the Gulf, reached a peak after the 1993 floods on the River.[505] One computer model has projected that continuing climate change will continue to produce

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UPDATE 14 (2001). *See also* JoAnn M. Burkholder, *Eutrophication and Oligotrophication*, *in* 2 ENCYCLOPEDIA OF BIODIVERSITY 649, 655-58 (Simon A. Levin ed., 2001).

500. Robert Costanza & Jack Greer, *The Chesapeake Bay and Its Watershed: A Model for Sustainable Ecosystem Management*, *in* ECOSYSTEM HEALTH 261 (David Rapport et al. eds., 1998).

501. Francis X. Clines, *Progress in Cleaning Chesapeake Bay, but Far to Go*, N.Y. TIMES, July 22, 2001, § 1, at 16.

502. JoAnn M. Burkholder, *Eutrophication and Oligotrophication*, *in* 2 ENCYCLOPEDIA OF BIODIVERSITY 649, 652 (Simon A. Levin ed., 2001).

503. The Science Museum of Minnesota has an interactive web site that illustrates the phenomenon of this "dead zone," *at* http://www.smm.org/DeadZone/top.html (last visited Sept. 17, 2001).

504. The largest zone of oxygen-depleted coastal waters in the United States, and the entire western Atlantic Ocean, is found in the northern Gulf of Mexico on the Louisiana and Texas continental shelf, influenced by the freshwater and nutrient flux of the Mississippi River system. Hypoxia covers broad regions of the shelf for extended periods in mid-summer. The mid-summer extent of hypoxic waters between 1985 and 1992 averaged 8,000 to 9,000 km2 but increased to between 16,000 and 18,000 km2 from 1993 to 1997. The prevailing oceanographic conditions in 1998 reduced the hypoxic zone to 12,480 km2. Low oxygen has been documented as early as February and as late as October, but is most widespread, persistent and severe from May to September in water depths of five to thirty meters. Hypoxia occurs mostly in the lower water column but may encompass as much as the lower half to two-thirds of the total water column. Continuous time-series data for the bottom waters in the core of the hypoxia region show (1) the gradual decline in oxygen in the spring with interruptions due to wind-mixing events, (2) persistent and severe hypoxia and anoxia for extended parts of the record from May to October, (3) occasional summer upwelling of oxygenated water from the outer shelf, and (4) the seasonal disruption of low oxygen in the fall from tropical storms or cold fronts.

Nancy N. Rabalais, *Hypoxia in the Gulf of Mexico*, 12 TUL. ENVTL. L.J. 321, 321-22 (1999) (footnotes omitted).

505. Mary L. Belefski & Larinda Tervelt Norton, *Hypoxia in the Gulf of Mexico: A Historical and Policy Perspective*, 12 TUL. ENVTL. L. J. 331, 337 (1999). A certain amount of nitrogen discharge is essential to the Gulf fisheries, but the growing hypoxia could adversely affect shrimp populations. *Id*. at 338.

heavier outflows from the Mississippi River and will increase the spread of the hypoxic area in both in space and time.[506]

Nitrogen originates from many natural sources as well as from human activities,[507] but the increasingly heavy applications of inorganic nitrogen-based fertilizer by farmers in the Mississippi watershed appear to be responsible for much of the increase.[508] Congress enacted legislation in 1998 directing the Office of Science and Technology Policy to develop a plan to address the hypoxia problem.[509]

Increased nitrogen discharge to coastal waters is widely recognized to be a worldwide problem.[510] The impact of nitrogen loadings on coastal waters of other countries is continuing inexorably, with the North Sea, the Black Sea, and the Baltic Sea, in particular, receiving a steadily growing nitrogen load.[511] In the

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506. Dubravko Justić et al., *Effects of Climate Change on Hypoxia in Coastal Waters: A Doubled CO_2 Scenario for the Northern Gulf of Mexico*, 41 LIMNOLOGY & OCEANOGRAPHY 992, 1001-02 (1996).

507. Long-term data that would document the occurrence of hypoxia earlier than the 1970s do not exist. Sediment cores from the Mississippi River bight provide surrogates for historical conditions in overlying waters and the benthic habitat. While century-long changes are evident in some of the retrospective analyses, the most dramatic and accelerating changes have occurred since the 1950s, when nitrogen loads began to increase and eventually doubled over their historic values . . . . Evidence associates oxygen depletion with changes in landscape use and nutrient management that result in nutrient enrichment of receiving waters. Nutrient flux in coastal systems, while essential to the overall productivity of those systems, has increased over time due to anthropogenic activities and has led to broad-scale degradation of the marine environment.

Rabalais, *supra* note 504, at 325-26 (footnotes omitted).

508. The most noticeable change in human activity in the watershed since the 1950s is in fertilizer application rates and changes in land use that affect the fate and transformation of nutrients before they reach the Gulf of Mexico. Animal husbandry practices have shifted to higher intensity operations. A small percentage of atmospheric nitrogen reaches the watershed, but it has likely increased over time. Wastewater treatment effluent is a small percentage of the nitrogen load. Efforts to manage nutrients should focus on those aspects of landscape architecture and human activities that show a documented effect in increasing eutrophication and worsening oxygen stress and on those that can be controlled.

Id. at 326 (1999) (footnotes omitted). The agricultural industry would of course expect to be subsidized for any reductions in nitrogen discharge. Belefski & Norton, *supra* note 505, at 347-48.

509. Pub. L. No. 105-383, § 601, 112 Stat. 3411, 3447 (1998). *See* Belefski & Norton, *supra* note 505, at 344-45.

510. For a UNEP summary of nitrogen loading issues, see www.unep.org/Geo2000/english/0036.htm (last visited Sept. 17, 2001).

511. DON HINRICHSEN, COASTAL WATERS OF THE WORLD: TRENDS, THREATS AND STRATEGIES 50, 58, 67 (1998); Sandy L. Tartowski & Robert W. Howarth, *Nitrogen, Nitrogen Cycle, in* 4 ENCYCLOPEDIA OF BIODIVERSITY 377, 381 (Simon A. Levin ed., 2001).

Baltic Sea, anoxic conditions in the lower layer of water cover an area of about 100,000 square kilometers for at least part of every year, resulting in dramatic declines in fish stocks.[512]

A further implication of increased human dispersal of nitrogen is a growing presence in the atmosphere of nitrous oxide (N_2O), a greenhouse gas that is about 300 times as powerful as carbon dioxide.[513] Recent studies suggest placing heavy emphasis on reducing especially powerful greenhouse gases such as nitrous oxide.[514] Currently extensive research is underway to try to find means of slowing the rate of nitrous oxide dispersion, which appears to be increasing at about 0.3% per year.[515]

iii. Reduction of Resource Availability

One of the common measures of ecological processes is "productivity," which relates to the amount of the sun's energy that is used to fix atmospheric carbon dioxide.[516] Some disturbances increase productivity by increasing resource availability. After a fire, for example, nutrients that were formerly in the living biomass become available as nutrients to plants and other organisms.[517] But at the reorganization stage, because the "system is underconnected, with weak organization and weak regulation," it is unstable, and chance events may allow a different species – perhaps an "exotic invader" – to become established.[518]

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512. KENNETH H. MANN, ECOLOGY OF COASTAL WATERS WITH IMPLICATIONS FOR MANAGEMENT 163 (2d ed. 2000).

513. SCHLESINGER, *supra* note 445, at 394. This problem was noted a decade ago in JONATHAN WEINER, THE NEXT ONE HUNDRED YEARS: SHAPING THE FATE OF OUR LIVING EARTH 50-51 (1990).

514. James Hansen et al., *Global Warming in the Twenty-First Century: An Alternative Scenario*, 97 PROC. NAT'L ACAD. SCI. USA 9875 (2000).

515. SCHLESINGER, *supra* note 445, at 10, 203, 393-96.

516. For a concise and readable account of the process, see E.C. PIELOU, THE ENERGY OF NATURE 116 *et. seq.* (2001). The standard methods of measuring productivity are discussed in NAT'L RESEARCH COUNCIL, *supra* note 3, at 90-102.

517. Holling refers to these processes of disturbance and reorganization as "creative destruction," and emphasizes that it is these processes that determine whether the ecological system can get back into the previous cycle or whether it collapses. C.S. Holling, *The Resilience of Terrestrial Ecosystems, in* THE DEVELOPMENT OF ECOLOGICAL ECONOMICS 107, 120-24 (Robert Costanza et al. eds., 1997). Holling refers to the third phase of the cycle as "creative destruction" with a bow to the economist, Joseph Schumpeter, who used that phrase to characterize capitalism.

518. Holling, *supra* note 335, at 65-66 (citing the rampant growth of Melaleuca in the Everglades as an example of exotic species that became dominant after human-caused disturbance). At the reorganization stage, when the system is weakly organized, it is most subject to "probabilistic events that allow a diversity of entrained species, as well as exotic invaders, to become established." Holling, *supra* note 139, at 482.

Other disturbances cause loss of resources from the system through, for example, volatilization or erosion,[519] which may lead to the collapse of the ecological system.[520] Pickett and White emphasize that "some disturbances may be so severe as to decrease resource availability or to obliterate the system completely."[521] For example, while natural forest fires typically cause little soil disturbance, extensive timber harvest often causes soil erosion and adversely impacts the character of forest streams.[522] Severe disturbance can also result from more subtle changes. For example, scattered urbanization may eliminate carnivores that were predators of the white-tailed deer, resulting in widespread habitat destruction caused by over-population of deer.[523]

If instability has been extreme, many species may be unable to subsist and the ecological system may collapse.[524] Ecological systems with low biological diversity may be especially susceptible to loss of resiliency.[525] Paleoecologists, who study the past through

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519. Ernst-Detlef Schulze & Harold A. Mooney, *Ecosystem Function of Biodiversity: A Summary*, *in* BIODIVERSITY AND ECOSYSTEM FUNCTION 497, 497-99 (Ernst-Detlef Schulze & Harold A. Mooney eds., 1994); HUSTON, *supra* note 285, at 227-28. For example, once pasture replaces tropical rainforest, the abandonment of the pasture will not result in a return to the rainforest; rather, a relatively barren landscape is likely to evolve. De Leo & Levin, *supra* note 116, at ¶ 31. *See also* Wayne C. Zipperer et al., *The Application of Ecological Principles to Urban and Urbanizing Landscapes*, 10 ECOLOGICAL APPLICATIONS 685, 685-86 (2000); Holling, *supra* note 139, at 480-81.

520. When a system becomes unstable, upper-level constraints cannot maintain the system's current configuration. There are two possible outcomes: either the system collapses to a diffuse, low level of organization; or, alternatively, a new set of upper-level constraints emerge and the system moves to a higher level of organization . . . . In both cases [what] disappears are the relationships that held the material in some special configuration.

AHL & ALLEN, *supra* note 124, at 171.

521. THE ECOLOGY OF NATURAL DISTURBANCE AND PATCH DYNAMICS, *supra* note 331, at 378. "Whether large disturbances are qualitatively different from numerous small disturbances remains an unresolved issue in ecology, in part because of a paucity of long-term data on the effects of large-scale disturbances and the impossibility of replicating such events." Turner & Dale, *supra* note 342, at 758.

522. Dale et al., *supra* note 47, at 653. Soil fertility is crucial. John J. Ewel, *Ecosystem Processes and the New Conservation Theory*, *in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 252, 259 (Steward T.A. Pickett et al. eds., 1997) ("To sustain biological richness, the abiotic features of the ecosystem must be retained, and in the case of terrestrial ecosystems the most vulnerable abiotic factor is soil fertility").

523. *See generally* Roger C. Anderson, *Native Pests: The Impact of Deer in Highly Fragmented Habitats*, *in* CONSERVATION IN HIGHLY FRAGMENTED LANDSCAPES 117 (Mark W. Schwartz ed., 1997). Aldo Leopold was one of the first to raise the public's consciousness of this phenomenon. CURT MEINE, ALDO LEOPOLD: HIS LIFE AND WORK 457-59 (1988).

524. Monica G. Turner & Virginia H. Dale, *Comparing Large, Infrequent Disturbances: What Have We Learned?*, 1 ECOSYSTEMS 493, 494 (1998).

525. Dale et al., *supra* note 47, at 650.

ice cores, tree rings, and other such evidence, can identify many examples of such system collapses.[526]

The ability to predict the point at which loss of resiliency would cause ecological collapse would be of great value.[527] Thus resource managers increasingly seek to stabilize disturbances at moderate levels,[528] believing that over time, "species diversity is likely to be maximized when the disturbance pattern resembles that historically characteristic of the community."[529] With that in mind, ecologists recognize the importance of the search for parameters that identify historical boundaries of ecological change.[530]

iv. Exceeding the Parameters of Natural Change

Although current ecology recognizes that change is a part of natural ecological processes, ecologists reject the use of the inevitability of change as an excuse to blindly alter or speed processes of change.[531] Instead, they seek to maintain ecological

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526. RICHARD T.T. FORMAN, LAND MOSAICS: THE ECOLOGY OF LANDSCAPES AND REGIONS 506-09 (1995); Hazel R. Delcourt & Paul A. Delcourt, *Paleoecological Analysis of the Legacy of Past Landscapes, in* ISSUES IN LANDSCAPE ECOLOGY 51 (John A. Wiens & Michael R. Moss eds., 1999).

527. Simon A. Levin, *Multiple Scales and the Maintenance of Biodiversity*, 3 ECOSYSTEMS 498, 502 (2000) (In some cases prediction is possible, but in others one must hope that reliance on precautionary principles will be sufficient).

528. A system that is in a constant steady state is not a system that is evolving, and therefore is not particularly resilient to a major disturbance of some kind because it is not in an "adaptive" mode. On the other hand, a system that gets so responsive that it is constantly adapting to every tiny input is so agitated that it may slip into chaos. It is the systems that are on the ridge between perfect stability and chaos that may be best situated to adapt to changing circumstances and therefore "improve" themselves over time.

George Frampton, *Ecosystem Management in the Clinton Administration*, 7 DUKE ENVTL. L. & POL'Y FORUM 39, 47 (1996). But Michael Bean expresses concern that this approach to resource management is so open-ended that it resembles the "multiple use" policy of natural resource management that has contributed to today's "conservation crises." Michael J. Bean, *Creating Policy on Species Diversity, in* BIODIVERSITY IN MANAGED LANDSCAPES 689, 696 (Robert C. Szaro and David W. Johnson eds., 1996). *See also* NAT'L RESEARCH COUNCIL, *supra* note 227, at 180. The objective of preserving entire ecosystems is not without its critics, in the form of some animal rights groups who argue that protection of natural communities rather than individual species is "ecological fascism" because it places the interest of the group ahead of the interest of the individual animal. TOM REGAN, THE CASE FOR ANIMAL RIGHTS 361-62 (1983).

529. Julie Sloan Denslow, *Disturbance-Mediated Coexistence of Species, in* THE ECOLOGY OF NATURAL DISTURBANCE AND PATCH DYNAMICS 307, 321 (S.T.A. Pickett and P.S. White, eds., 1985).

530. NAT'L RESEARCH COUNCIL, *supra* note 227, at 111-23 (1995).

531. Michael E. Soulé, *The Social Siege of Nature, in* REINVENTING NATURE: RESPONSES TO POSTMODERN DECONSTRUCTION 137, 154-60 (Michael E. Soulé & Gary Lease eds., 1995) (rejecting the argument that since nature is no longer natural, we can do whatever we want to it). *See also* Christensen et al., *supra* note 134, at 675 (pointing out that logging, for example, only superficially resembles the effects of fire on a forest).

processes by keeping change within its historical range of variability.[532] Increasingly, ecologists are concerned that the steady increase in the human alteration of natural environments is so different from the kinds of cyclical disturbances that have occurred in the past – even during the great mass extinctions of prehistoric times – that we cannot expect ecological systems to recover to their previous states.[533]

For example, the scientific advisory committee that was appointed to advise the United States Forest Service about forest management recommended that ecological sustainability should be the foundation for forest management and that such sustainability should be achieved by ascertaining the historical range of variability of the ecological processes of a planning area, such as soil fertility, productivity, and biochemical cycles:

> Because ecosystems are dynamic and variable, the concept of the "historic range of variability" is used to characterize the variation and distribution of ecological conditions occurring in the past. This concept allows one to compare the ecological conditions that will be created under proposed management scenarios to past conditions. The more the prospective conditions differ from the conditions during recent millennia, the greater the expected risk to native species, their habitats, and the long-term stability of ecological processes.[534]

Excess disturbance may also significantly reduce an ecological system's productivity.[535] For example, where suppression of the normal forest fire cycle has caused heavy buildup of dead wood on

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532. David Tilman & Clarence Lehman, *Human-caused Environmental Change: Impacts on Plant Diversity and Evolution*, 98 PROC. NAT'L ACAD. SCI. USA 5433 (2001).

533. Michael L. Rosenzweig, *Loss of Speciation Rate Will Impoverish Future Diversity*, 98 PROC. NAT'L ACAD. SCI. USA 5404 (2001).

534. COMM. OF SCIENTISTS, U.S. DEP'T OF AGRIC., SUSTAINING THE PEOPLE'S LANDS: RECOMMENDATIONS FOR STEWARDSHIP OF THE NATIONAL FORESTS AND GRASSLANDS INTO THE NEXT CENTURY 147 (March 15, 1999). *See also* Ken Lertzman & Joseph Fall, *From Forest Stands to Landscapes: Spatial Scales and the Roles of Disturbances*, *in* ECOLOGICAL SCALE: THEORY AND APPLICATIONS 339, 366-67 (David L. Peterson & V. Thomas Parker eds., 1998). For a discussion of the committee report, see Charles F. Wilkinson, *A Case Study in the Intersection of Law and Science: The 1999 Report of the Committee of Scientists*, 42 ARIZ. L. REV. 307 (2000).

535. Productivity refers to the extent to which an ecological system can convert the sun's energy into matter and is measured by weighing the accumulated biomass and determining the amount of energy necessary to support that biomass. A DICTIONARY OF ECOLOGY, *supra* note 147, at 316-18. For a discussion of the origins of the productivity concept, see DONALD WORSTER, NATURE'S ECONOMY: A HISTORY OF ECOLOGICAL IDEAS 306-11 (2d ed. 1994).

the ground, a fire that eventually occurs may be so hot as to destroy soil bacteria that would have remained viable in a normal fire.[536] If a critical mass of resources is lost in the renewal process, the system may collapse. Thus, if a forest fire is followed by heavy rains before adequate revegetation, sufficient soil may be eroded such that the area will no longer support a forest.[537]

Ecologists believe that they will be able to identify parameters that bound the limits of many kinds of ecological systems to absorb such changes without collapsing.[538] The ability of a system to return to its normal dynamics after perturbation has been called its "homeorhetic stability";[539] where such stability exists, the system tends to return to its original "preperturbation *trajectory* or rate of change."[540] Holling thinks that many terrestrial ecological systems seem to keep most of their functions under stress even though species composition changes.[541]

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536. Virginia H. Dale et al., *Ecological Principles and Guidelines for Managing the Use of Land*, 10 ECOLOGICAL APPLICATIONS 639, 653 (2000). *See* Turner & Dale, *supra* note 342, at 760; Mark W. Schwartz & Sharon M. Hermann, *Midwestern Fire Management: Prescribing a Natural Process in an Unnatural Landscape, in* CONSERVATION IN HIGHLY FRAGMENTED LANDSCAPES 213, 222-24 (Mark W. Schwartz ed., 1997).

537. Robert T. Paine et al., *Compounded Perturbations Yield Ecological Surprises*, 1 ECOSYSTEMS 535 (1998) (collapse is often caused when different kinds of disturbance take place within a short time frame); Holly T. Dublin et al., *Elephants and Fire as Causes of Multiple Stable States in the Serengeti-Mara Woodlands*, 59 J. OF ANIMAL ECOLOGY 1147 (1990) (combination of fire and elephants convert forests to grassland); Hans W. Paerl et al., *Ecosystem Impacts of Three Sequential Hurricanes (Dennis, Floyd, and Irene) on the United States' Largest Lagoonal Estuary, Pamlico Sound, NC*, 98 PROC. NAT'L ACAD. SCI. USA 5655 (2001) (explaining that if the frequency of hurricanes increases due to climate change, it may cause long-term changes in coastal habitats).

538. Judy L. Meyer, *The Dance of Nature: New Concepts in Ecology*, 69 CHI.-KENT L. REV. 875, 882 (1994). Michael Huston has proposed a model for evaluating the impact of disturbance dynamics on biological diversity in which the key variables are frequency or intensity of disturbances on the vertical axis and rate of population growth and competitive displacement on the horizontal axis. Maximum diversity occurs when conditions are roughly equal on each scale. MICHAEL A. HUSTON, BIOLOGICAL DIVERSITY: THE COEXISTENCE OF SPECIES ON CHANGING LANDSCAPES 131-55 (1994). Experiments involving the gradual removal of single species and the measurement of the effect of the removal on the remaining system suggest that "systems have an appreciable buffering capacity to compensate for species loss but that there is a threshold of change that will overwhelm the damping effect of biodiversity, with an associated break point of ecosystem function to quite different levels." Ernst-Detlef Schulze & Harold A. Mooney, *Ecosystem Function of Biodiversity: A Summary*, *in* BIODIVERSITY AND ECOSYSTEM FUNCTION 497, 501 (1994).

539. Jianguo Wu & Orie L. Houcks, *From Balance of Nature to Hierarchical Patch Dynamics: A Paradigm Shift in Ecology*, 70 Q. REV. BIOLOGY 439, 444 (1995).

540. Christensen et al., *supra* note 134, at 675 (emphasis in original).

541. "One recent explanation for this resilience and robustness" is that a relative few processes set the rhythm of ecological system dynamics. The diversity of species can be traced to "the function of a small set of variables and the niches they provide . . . . Therefore, these structuring variables are where the priority should be placed in investing to protect or enhance diversity." C.S. Holling et al., *Biodiversity in the Functioning of Ecosystems: An Ecological Synthesis, in* BIODIVERSITY LOSS: ECONOMIC AND ECOLOGICAL ISSUES 44, 48, 70 (Charles Perrings et al. eds., 1995). *See also* Anthony W. King, *Considerations of Scale and*

The emphasis on the importance of post-disturbance reconstruction leads ecologists to search for key structuring variables[542] that control reorganization.[543] Because the recognition of the importance of disturbance is relatively recent, post-disturbance phenomena have not been studied with the kind of standard protocols that would make it easy to do comparative research.[544] For some ecological functions, threshold variables indicating how much disturbance can be sustained before the system loses predictability can probably be ascertained.[545] These parameters may involve factors such as biomass volume, relative energy flows to various food chains, and mineral micro-nutrient stocks.[546] The rate of change may prove to be a key factor.[547]

Hierarchy, *in* ECOLOGICAL INTEGRITY AND THE MANAGEMENT OF ECOSYSTEMS 19, 25-27 (Stephen Woodley et al. eds., 1993) (many ecosystems retain resilience despite change in individual components); John A. Bissonette, *Scale-Sensitive Ecological Properties: Historical Context, Current Meaning*, *in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 3, 24 (John A. Bissonette ed., 1997) (identification of structuring variables would provide predictive theory for ecosystem changes across scales).

542. Ecologists use techniques such as gradient analysis and boundary analysis to understand trajectories of ecological change and facilitate selection of effective measurable parameters for assessing changes in the state of terrestrial ecological systems. KRISTIINA A. VOGT ET AL., ECOSYSTEMS: BALANCING SCIENCE WITH MANAGEMENT 224-34 (1996). *See also* Steward T.A. Pickett & Kevin H. Rogers, *Patch Dynamics: The Transformation of Landscape Structure and Function*, *in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 101, 122 (John A. Bissonette ed., 1997) (integration of gradient analysis and patch perspective is needed); V.T. Parker & S.T.A. Pickett, *Restoration as an Ecosystem Process: Implications of the Modern Ecological Paradigm*, *in* RESTORATION ECOLOGY AND SUSTAINABLE DEVELOPMENT 17, 28 (Krystyna M. Urbanska et al. eds., 1997); Roy Haines-Young, *Landscape Pattern: Context and Process*, *in* ISSUES IN LANDSCAPE ECOLOGY 33, 34 (John A. Wiens & Michael R. Moss eds., 1999).

543. *See, e.g.*, Norman L. Christensen, Jr., *Managing for Heterogeneity and Complexity on Dynamic Landscapes*, *in* THE ECOLOGICAL BASIS OF CONSERVATION: HETEROGENEITY, ECOSYSTEMS, AND BIODIVERSITY 167 (Steward Pickett et al., eds., 1997); Virginia H. Dale et al., *Ecosystem Management in the Context of Large, Infrequent Disturbances*, 1 ECOSYSTEMS 546, 552-54 (1998).

544. Turner & Dale, *supra* note 342.

545. Charles Perrings, *Biodiversity Conservation as Insurance*, *in* THE ECONOMICS AND ECOLOGY OF BIODIVERSITY DECLINE: THE FORCES DRIVING GLOBAL CHANGE 69, 71-72 (Timothy M. Swanson ed., 1995).

546. Mick Common & Charles Perrings, *Towards an Ecological Economics of Sustainability*, 6 ECOLOGICAL ECONOMICS 7, 31 (1992).

547. Theoretical studies examining the effects of landscape spatial pattern, when that pattern changes over time, have generally found that the rate of change in landscape pattern is far more important than the spatial pattern itself in affecting population survival. Aspects of spatio-temporal pattern are, for disturbances, disturbance rate, disturbance size, and temporal correlation in disturbances, and for ephemeral patches, rate of patch formation and patch lifespan.

Susan Harrison & Lenore Fahrig, *Landscape Pattern and Population Conservation*, *in* MOSAIC LANDSCAPES AND ECOLOGICAL PROCESSES 293, 297 (Lennart Hansson et al. eds., 1995).

Similar searches for predictive processes are underway in regard to aquatic environments. Such environments sometimes appear to be unpredictable chaotic systems, but ecologists increasingly believe that the systems' cyclical variations are kept within limits set by system parameters and that the management goal should be to maintain the chaotic system within its normal range of variation by ensuring that the parameters of the system are not exceeded.[548] In fisheries, for example, these parameters are the ecological characteristics that determine growth, reproduction, migration, hierarchy, and predation.[549] These factors are not always appreciated by those with short-term interests in the catch.[550]

As ecologists have increasingly recognized the important role that disturbance plays in the ecological cycle, it has become apparent that human response to the reorganization that follows disturbance plays a crucial role in sustaining the long-term health of the ecological system.[551] Historically, however, our responses to disturbance of the environment have focused almost exclusively on the immediate human losses that accompany the disturbance, with much less attention being paid to the long range impact on the ecology, the eventual economic impact of which may be much greater.[552] We provide insurance so that people can rebuild in flood plains or after hurricanes or fires, but we have paid little attention to efforts to ensure that the natural environment can effectively renew itself and continue to provide the ecological values to which we are accustomed.[553]

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548. Judy L. Meyer, *The Dance of Nature: New Concepts in Ecology*, 69 CHI.-KENT L. REV. 875, 882 (1994).

549. James A. Wilson et al., *Chaos, Complexity and Community Management of Fisheries*, 18 MARINE POLICY 291, 297-98 (1994) ("These aspects of a chaotic system can be learned. We can also learn when, what and how *not* to fish so that we do not disrupt the basic functioning of the system.").

550. A report by the National Research Council recommended that fishing regulators "recognize the importance of species interactions, conserve biodiversity, and permit utilization only when the ecosystem or its productive potential is not damaged." COMM. ON ECOSYSTEM MGMT. FOR SUSTAINABLE MARINE FISHERIES, NAT'L RESEARCH COUNCIL, SUSTAINING MARINE FISHERIES 113 (1999). For a readable account of some of the issues involved in applying ecological concepts to the oceans, see CARL SAFINA, SONG FOR THE BLUE OCEAN (1997).

551. Dale et al., *supra* note 543, at 551-53 ("The first step in managing recovery is to evaluate the site potential.").

552. Claudia Pahl-Wostl, *Ecosystem Organization Across a Continuum of Scales: A Comparative Analysis of Lakes and Rivers*, *in* ECOLOGICAL SCALE: THEORY AND APPLICATIONS 141, 147 (David L. Peterson & V. Thomas Parker eds., 1998) (human management of lakes and rivers may cause extreme floods to become more common).

553. DENNIS S. MILETI, DISASTERS BY DESIGN: A REASSESSMENT OF NATURAL HAZARDS IN THE UNITED STATES 31-33 (1999).

Some ecologists suggest that hierarchically organized ecological systems may have "natural integrators" that can serve as measures of ecological system integrity in a manner roughly analogous to the way that the body temperature of warm-blooded animals serves as an indicator of health.[554] For example, soil characteristics produced by geological forces have a major impact on ecological processes such as patterns of species diversity, endemism, and productivity.[555] Sometimes the integrator may be more indirect, such as when the foraging process of a wolf pack is a key factor affecting the "temporal and spatial variability of their prey."[556]

Although ecologists are still at an early stage in the process of trying to identify the indicators of resilience,[557] the availability of large-scale ecological research methodology makes the task seem less hopeless. Certainly our traditional methods of managing natural resources have failed to produce resilient ecological systems, and the need to pin down indicators of resilience should have high priority.[558] A panel of the National Research Council recently concluded: "[W]ithout quantitative theories, we have only limited ability to predict rates of change or specific losses and gains that will follow a perturbation in the environment . . . . [A] concerted effort during the coming decade could bring substantial advances."[559]

The first parts of this article explored some of the ideas that have been generated by research in ecology at large scales. Large-scale ecology tells us that competition rarely produces a survival of the fittest except in narrowly confined environments and that coexistence is the norm in variable environments. It suggests that our concern with habitat fragmentation ought to be limited to those habitats where extensive homogeneity is really needed to prevent extinction. It leads us to appreciate that disturbance, within historical limits, may be a necessary element of ecological processes. Furthermore, it leads us to hope that if we can keep human changes

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554. King, *supra* note 541, at 35-36; NAT'L RESEARCH COUNCIL, *supra* note 3, at 23-25 (2000).

555. Michael Huston, Dirt is Destiny: Common Constraints on Plants, Animals, and People (unpublished paper delivered at the Conference on Integration across Ecological Scales, Tex. A & M Univ., Feb. 25, 2000) (on file with author).

556. King, *supra* note 541, at 36.

557. *See* Daniel Simberloff, *Flagships, Umbrellas, and Keystones: Is Single-Species Management Passé in the Landscape Era?*, 83 BIOLOGICAL CONSERVATION 247, 254-55 (1998) (Identification of keystone species may lead to understanding of reorganization processes).

558. *See generally* Carl Folke et al., *Ecological Practices and Social Mechanisms for Building Resilience and Sustainability*, *in* LINKING SOCIAL AND ECOLOGICAL SYSTEMS: MANAGEMENT PRACTICES AND SOCIAL MECHANISMS FOR BUILDING RESILIENCE 414, 428-31 (Fikret Berkes & Carl Folke eds., 1998).

559. COMM. ON GRAND CHALLENGES IN ENVTL SCIENCES, NAT'L RESEARCH COUNCIL, GRAND CHALLENGES IN ENVIRONMENTAL SCIENCES 22 (2001) (citations omitted).

to the environment within historical parameters, we have hope of obtaining a metastability that will minimize the collapse of ecological systems. But it also suggests that unless we can bring under control the gradual alterations of the environment that produce unidirectional change, we may be creating risks beyond the ability of science to predict. The remainder of the article looks at policy implications of these ideas.

IV. PROPOSALS FOR LAWMAKERS

Today's legal scholarship increasingly recognizes that laws dealing with natural resources need to be reevaluated in light of current scientific knowledge on large-scale ecology.[560] My reading of the scientific literature on ecology has led me to make the following suggestions for policies and programs that lawmakers should consider. I have limited these suggestions to ideas derived from large-scale ecology, recognizing however that other types of ecological research also should be the basis for policy recommendations. Moreover, I have not included recommendations on the kind of additional research that the government should fund, although that is clearly an important issue.

A. Use Better Ecological Data in Implementing Laws

Although the technology for generating ecological data has improved greatly, the efforts to obtain and disseminate such data are far from ideal. The following suggestions are examples of ways in which such data could be made more broadly available so that it could be more effectively utilized in the implementation of a wide range of existing laws.

1. Facilitate Access to Large-Scale Ecological Information

Large-scale ecology requires the collection and analysis of enormous quantities of biological information. Modern satellites and computers make this possible, but it can be very expensive.[561]

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560. My colleague Dan Tarlock has been one of the leaders in this reevaluation. *See* A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOY. L.A. L. REV. 1121 (1994). *See also* A. Dan Tarlock, *Environmental Law: Ethics or Science?*, 7 DUKE ENVTL. L. & POL'Y F. 193 (1996). Eric Freyfogle has pointed out that Aldo Leopold was one of the early observers to recognize that human-induced changes caused damage, not because they disrupted a static balance of nature, but because they altered dynamic and flexible environments too violently and rapidly. Eric T. Freyfogle, A Sand County Almanac *at 50: Leopold in the New Century*, 30 ENVTL. L. REP. 10058, 10063-64 (2000). *See also* Doremus, *supra* note 485, at 33-35.

561. *See generally* S.A. DRURY, IMAGES OF THE EARTH: A GUIDE TO REMOTE SENSING (2d ed. 1998); Barry L. Johnson, *The Role of Adaptive Management as an Operational Approach for*

National governments should take the lead in making this data available for research.

i. Proceed to Implement a National Biological Survey

In September, 1993, Secretary of the Interior Bruce Babbitt proposed the creation of a new entity within the Department of the Interior to collect and analyze biological information. His goal, as his Solicitor John Leshy explained, was "to insulate research science from applied science in the Department by creating the National Biological Survey (NBS). Babbitt saw NBS, staffed with research scientists drawn from the Department's several bureaus, as the biology counterpart of the venerable U.S. Geological Survey, founded by the icon John Wesley Powell."[562] It was to be called the National Biological Survey to establish its status as a parallel to the older U.S. Geological Survey. [563] The idea of such an entity was not new; a division or bureau of biological survey had been in existence since 1896, until it was merged into the new Fish and Wildlife Service in 1939.[564]

Babbitt's proposal was supported by a report by the National Research Council endorsing the idea of an institution that would have the responsibility for "inventorying, mapping, and monitoring biotic resources; performing basic and applied research on species, groups of species, populations, and ecosystems; and providing the scientific support and technical assistance needed for management and policy decisions in DOI."[565] Secretary Babbitt created the NBS by executive order, and the NBS entered into cooperative agreements with various state agencies to obtain and monitor biological data.[566] These actions generated a good deal of optimism that funds would be made available for better biological data.[567] Unfortunately, the NBS proposal ran into what Joseph Sax has aptly characterized as the "ecologically backward-looking" Congress

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Resource Management Agencies, 3(2) CONSERVATION ECOLOGY 8 (1999), *available at* http://www.consecol.org/vol3/iss2/art8.

562. John D. Leshy, Essay, *The Babbitt Legacy at the Department of the Interior: A Preliminary View*, 31 ENVTL. L. 199, 206 (2001).

563. J.B. Ruhl, *Biodiversity Conservation and the Ever-expanding Web of Federal Laws Regulating Nonfederal Lands: Time for Something Completely Different?*, 66 U. COLO. L. REV. 555, 574 (1995).

564. The chronology of the biological survey is explained on the web page of the Biological Division of the United States Geological Survey, *at* http://biology.usgs.gov (last visited Jan. 12, 2002).

565. COMM. ON THE FORMATION OF THE NAT'L BIOLOGICAL SURVEY, NAT'L RESEARCH COUNCIL, A BIOLOGICAL SURVEY FOR THE NATION viii (1993).

566. Ruhl, *supra* note 563, at 574-75.

567. Robert B. Keiter, *Beyond the Boundary Line: Constructing a Law of Ecosystem Management*, 65 U. COLO. L. REV. 293, 323-33 (1994).

that was elected in November, 1994.[568] What remained at the end of Babbitt's tenure was a small unit within the United States Geological Survey that is currently doing important biological research, but its future is questionable, and its funding has never been adequate.[569]

The need for consolidation and analysis of biological data on a national and global basis is one of the top priorities of scientists seeking to cope with losses of biological diversity.[570] Congress should re-examine the sound conclusions of the 1993 National Research Council Report and institute a National Partnership for a Biological Survey in the form the Council recommended. It would provide a more efficient information base from which to make planning decisions and would create an "organized framework for collaboration among federal, regional, state, and local organizations, both public and private."[571]

ii. Make Ecological Data Readily Available

A great deal of long term ecological data was collected before modern systems of data storage and retrieval were available. There is a pressing need for funds to digitize this information and to publish it in usable form, complete with documentation about how the data was collected.[572] Current data also needs to be quickly accessible at reasonable cost. The scientific community has long held somewhat ambivalent feelings about the desire to obtain better data. Although each scientist would like to have access to as much data as possible, that same scientist may be quite reluctant to disclose data prior to its publication. This reflects both the competitive realities of the race to get credit in the academic community for being the first to publish and the danger that data released before being thoroughly tested and checked would be the source of potential embarrassment.[573]

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568. Joseph L. Sax, Comment on John Harte's Paper, "*Land Use, Biodiversity, and Ecosystem Integrity: The Challenge of Preserving Earth's Life Support System*", 27 ECOLOGY L.Q. 1003, 1009 (2001).

569. Thomas E. Lovejoy, *The Quantification of Biodiversity: An Esoteric Quest or a Vital Component of Sustainable Development?*, *in* BIODIVERSITY: MEASUREMENT AND ESTIMATION 81, 82 (D.L. Hawksworth ed., 1995) (Most people labor under an "illusion that all that really matters is a handful of plant and animal species used as foods enlivened by a few more used as spices, with a couple of domestic animals such as dogs or cats thrown in for amusement.").

570. Robert M. May, *Conceptual Aspects of the Quantification of the Extent of Biological Diversity*, *in* BIODIVERSITY: MEASUREMENT AND ESTIMATION 13, 18-19 (D. L. Hawksworth ed., 1995).

571. NAT'L RESEARCH COUNCIL, *supra* note 565, at 54.

572. *See generally* Ad Hoc Committee of the Ecological Soc'y of Am., Report of the Committee on the Future of Long-term Ecological Data (1995).

573. Robert L. Fischman & Vicky J. Meretsky, *Endangered Species Information: Access and*

Some businesses will pay significant sums for ecological data, but much ecological research is done by nonprofit institutions. It is important to keep in mind that charging for data may make it difficult to acquire such data for those who are not involved in converting land to economic benefit.[574] The National Research Council has noted that although new information technology has generally provided expanded access to government data, "in some parts of the government, the evolution of the information infrastructure has instead been associated with a trend toward the commercialization of government information, increasingly limiting the amounts of information that can be accessed inexpensively by the public."[575]

Under the Freedom of Information Act (FOIA),[576] federal government agencies and any other entities receiving federal funding must disclose scientific data only if it has been relied on as the basis for a government decision or if it has served as the basis of a formal scientific publication.[577] Robert Fischman and Vicky Meretsky have pointed out that the delay between the collection of ecological data and its publication may lead to poor decision making in fields such as conservation biology that require immediate decisions based on the best data available.[578]

The National Research Council recommends that "[a]s a general principle, the basic data created or collected by the federal government should be available at a modest cost, usually not to exceed the direct costs associated with distribution of the data."[579] This is an important recommendation and should be implemented. In addition, many ecological data systems could probably be treated as "open source" technology that could be built on freely by

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Control, 41 WASHBURN L. J. 90, 111-13 (2001) (suggesting that scientists be required to provide annual reports on long term studies that affect critical species).

574. For a discussion of the history of efforts to regulate the cost of remote sensing data, see Charles Davies et al., *Moving Pictures: How Satellites, the Internet, and International Environmental Law Can Help Promote Sustainable Development*, 28 STETSON L. REV. 1091, 1139-41 (1999). *See also* Jeremy Speich, Comment, *The Legal Implications of Geographical Information Systems (GIS)*, 11 ALB. L.J. SCI. & TECH. 359, 378-80 (2001) (cost of GIS data remains a problem).

575. COMM. ON INTELLECTUAL PROPERTY RIGHTS AND THE EMERGING INFORMATION INFRASTRUCTURE, NAT'L RESEARCH COUNCIL, THE DIGITAL DILEMMA: INTELLECTUAL PROPERTY IN THE INFORMATION AGE (2000); Executive Summary *reprinted in* 62 OHIO ST. L.J. 951, 959-60 (2001).

576. 5 U.S.C. § 552 (2000).

577. OMB Circular A-110, 64 Fed. Reg. 54,926, 54,927-30 (Oct. 8, 1999).

578. Fischman & Meretsky, *supra* note 573.

579. NAT'L RESEARCH COUNCIL, *supra* note 575, at 960.

scientists throughout the world.[580] This would facilitate further advances in ecological data collection and processing.

2. Develop Performance Standards for Alteration of Ecological Processes

The more science learns about ecological processes, the more difficult it has been to pin down precise criteria for deciding whether changes in the processes are good or bad. In an environment where ecological conditions are undergoing constant change, how do you decide whether a particular change is both abnormal and undesirable?[581] United States government scientists have been simultaneously developing two approaches: (1) procedures to evaluate risks to ecological functions,[582] and (2) establishment of indicators that can measure future changes in ecological systems.[583]

i. Use Ecological Risk Assessment Procedures

The Scientific Advisory Board (SAB) of the United States Environmental Protection Agency (EPA) has been wrestling with the problem of adjusting the agency's planning to modern concepts of ecological science.[584] In 1998, the EPA published guidelines for ecological risk assessment based on the SAB's work.[585] The guidelines illustrate the difficulty of defining adverse ecological effects.

The new ecological risk assessment procedures are phrased in bureaucratic jargon, but the basic outlines of the process can be easily understood. The first phase of the process, called "problem formulation," generates and evaluates preliminary ideas about "why ecological effects have occurred, or may occur, from human activities."[586] The second phase of the process, the analysis phase,

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580. On the open source approach, see Shawn W. Potter, *Opening Up to Open Source*, 6 RICH. J.L. & TECH. 24 (2000).

581. "Communities and ecosystems are in constant flux, even without human interference," so how do we define a "normal state, and how do we separate, except in the most obvious cases, the effects of human and natural disturbances?" DAVID EHRENFELD, BEGINNING AGAIN: PEOPLE AND NATURE IN THE NEW MILLENNIUM 141 (1993).

582. *See* notes *infra* 584-97.

583. *See* notes *infra* 598-611. For a perspective on ecological impact assessment under the European Union rules, see JO TREWEEK, ECOLOGICAL IMPACT ASSESSMENT (1999).

584. See THE REPORT OF THE RESEARCH STRATEGIES COMM., U.S. EPA, FUTURE RISK: RESEARCH STRATEGIES FOR THE 1990S (1988).

585. Guidelines for Ecological Risk Assessment, 63 Fed. Reg. 26,845 (May 14, 1998). For an external review draft of a supplemental EPA publication, see *Planning for Ecological Risk Assessment: Developing Management Objectives*, *at* http://www.epa.gov/ncea/raf/dmo.htm (June 2001).

586. The first phase of the process should result in agreement on the identification of: (1)

examines the relationship of the stressors and targets in more detail. The result is called a "stressor-response profile."[587] The third phase is the preparation of a risk characterization report containing (1) quantified or qualitative estimates of the extent of the risk created by various stressors; (2) recommended management and research tasks aimed at reducing and better understanding the risk; and (3) a monitoring program to provide continuing evaluation and revision of the management activities.[588]

The most interesting part of the guidelines is the discussion of how one decides whether a stressor's impact is adverse.[589] The guidelines offer the following criteria for "evaluating adverse changes" in assessment endpoints: (1) "[n]ature of effects and intensity of effects"; (2) "[s]patial and temporal scale"; and (3) "[p]otential for recovery."[590] They recognize that "[n]atural ecosystem variation can make it very difficult to observe (detect) stressor-related perturbations," given such things as natural fluctuations in populations of species and cyclic events such as migrations and tides which may "mask or delay stressor-related effects."[591]

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targets (or endpoints, as they are called in the Guidelines), which are ecological objectives that can be measured (e.g., nesting success of target species, presence of certain pollutants in water, etc.); (2) a conceptual model that describes the processes by which it is assumed that "stressors" may be affecting the ecological objectives; and (3) an analysis plan to evaluate risk hypotheses to determine how they will be assessed. Selection of measurable endpoints should concentrate on those factors that "help sustain the natural structure, function, and biodiversity of an ecosystem" and that are sensitive to change caused by stressors. Conceptual models for ecological risk assessment are to be developed "from information about stressors, potential exposure, and predicted effects on an ecological entity (the assessment endpoint)." Uncertainty can be reduced by developing alternative models which will be revisited and revised if necessary during the assessment process. Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,851-64.

587. Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,873. This includes figuring out how the adverse impact takes place (called "exposure analysis" by the EPA), and using an "ecological response analysis" to evaluate (1) "how the magnitude of the effects change with varying stressor levels," (2) whether the evidence shows "that the stressor causes the effect," and (3) whether there is a link between the effects and the assessment endpoint. Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,873.

588. Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,882.

589. After the changes in the endpoints have been estimated, "[t]he next step is to interpret whether these changes are considered adverse. Adverse ecological effects, in this context, represent changes that are undesirable because they alter valued structural or functional attributes of the ecological entities under consideration. The risk assessor evaluates the degree of adversity, which is often a difficult task and is frequently based on the risk assessor's professional judgment." Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,890.

590. Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,890.

591. Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,890. The guidelines go on to point out that fluctuations may seem more or less important depending on how large an area is surveyed and how long a time frame is considered. Guidelines for Ecological Risk Assessment, 63 Fed. Reg at 26,891.

The guidelines define recovery as "the rate and extent of return of a population or community to some aspect of its condition prior to a stressor's introduction . . . . Because ecosystems are dynamic and, even under natural conditions, constantly changing in response to changes in the physical environment (e.g., weather, natural disturbances) or other factors, it is unrealistic to expect that a system will remain static at some level or return to exactly the same state that it was before it was disturbed."[592] The extent to which changes are reversible, the existence of a natural disturbance pattern, and the likely rate of recovery should be considered.[593]

When the final guidelines are compared with the proposed guidelines published in 1996,[594] one can see that the authors became increasingly troubled with the issue of how to determine whether a change is adverse. This led to a concern that better ecological indicators were needed to provide baselines against which the magnitude and direction of change could be ascertained.[595] The highly technical language of the guidelines[596] also reinforced the need to provide indicators that communicated information that the public could easily understand.[597] Apparently in response to these concerns, the EPA asked the National Research Council to undertake a study of potential "ecological indicators."[598] The Council's report was published in 2000.[599]

ii. Adopt Ecological Indicators

The scientists who wrote the Council's report looked with obvious envy at the precision and neutrality that have long been

592. Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,891 (citation omitted).
593. Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,891.
594. Proposed Guidelines for Ecological Risk Assessment, 61 Fed. Reg. 47,552 (Sept. 9, 1996). For comments on the earlier draft, see Lisa Heinzerling, *Reductionist Regulatory Reform*, 8 FORDHAM ENVTL. L.J. 459, 466-72 (1997).
595. U.S. EPA, EVALUATION GUIDELINES FOR ECOLOGICAL INDICATORS (Laura Jackson et al. eds., 2000).
596. For a comment on the guidelines, see United States Army Legal Services Agency, *Environmental Law Division Notes*, 1999 ARMY LAW. 38, 39-41 (1999).
597. Andrew Schiller et al., Communicating Ecological Indicators to Decision Makers and the Public, 5 CONSERVATION ECOLOGY (1) 19 (2001), *available at* www.consecol.org/vol5/iss1/art19.
598. The National Research Council is the research arm of the National Academy of Sciences and the National Academy of Engineering.
599. NAT'L RESEARCH COUNCIL, *supra* note 3. For another version of ecological indicators, see Mark A. Harwell et al., *A Framework for an Ecosystem Integrity Report Card*, 49 BIOSCIENCE 543 (1999). *See also* INTEGRATING ECONOMIC AND ECOLOGICAL INDICATORS: PRACTICAL METHODS FOR ENVIRONMENTAL POLICY ANALYSIS (J. Walter Milon & Jason F. Shogren eds., 1995).

attributed to some of the national economic indicators.[600] They explicitly defined their search criteria to focus on indicators that would quantify and "simplify information about complex phenomena to improve communication."[601] Quite naturally, the Council interpreted its charge as both scientific and educational.

Like the EPA, the Council recognized the difficulty of identifying "normal" baselines against which to compare the current status of any indicator. Not only are many ecosystems and habitats poorly understood, but most ecosystems are characterized by large-scale fluctuations in which the abundance of species may change dramatically, seasonally and from year to year.[602] "Therefore, baselines must specify typical patterns of variation and incorporate ways of deciding whether a particular fluctuation or trend falls outside the bounds of 'normal' variation. The greater the normal variability in an ecosystem, the more difficult it is to identify abnormal variation."[603] The report also recognizes that it will be crucial to define the spatiotemporal scale at which an indicator is used.[604]

The report recommends specific indicators for which national data should be generated and published: (1) "Land Cover and Land Use," (2) "Total Species Diversity," (3) "Native Species Diversity," (4) "Nutrient Runoff," (5) "Soil Organic Matter," (6) "Productivity, including Carbon Storage, Net Primary Production (NPP), and Production Capacity," (7) "Lake Trophic Status," (8) "Stream Oxygen," and (9) "Nutrient-Use Efficiency and Nutrient Balance."[605] The Council says that although these indicators are "well grounded in theory and supported by extensive data, further research . . . might also suggest new indicators that are better than or that can be added to the set of indicators then in use."[606]

Although other studies of potential ecological indicators are also underway,[607] lawmakers should begin to implement the Council's

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600. NAT'L RESEARCH COUNCIL, *supra* note 3, at 19 ("Thousands of people pay close attention to changes in the gross domestic product").

601. *Id*. at 27. The report also acknowledges that "[e]cological indicators must be developed and used with the knowledge that substantial uncertainty will always exist." *Id*. at 26.

602. *See, e.g.*, J. E. Hewitt et al., *Assessing Environmental Impacts: Effects of Spatial and Temporal Variability at Likely Impact Scales*, 11 ECOLOGICAL APPLICATIONS 1502 (2001) (noting difficulty of assessing impact under conditions of spatial and temporal variability). *See generally* IAN F. SPELLERBERG, MONITORING ECOLOGICAL CHANGE (1991).

603. NAT'L RESEARCH COUNCIL, *supra* note 3, at 24.

604. *Id*. at 54.

605. *Id*. at 66. The search for indicators is also taking place at an international level. *See* Virginia H. Dale, *Criteria and Indicators for Assessing Sustainability of Forest Management: Conservation of Biodiversity*, 78 BULL. ECOLOGICAL SOC'Y OF AM. 291 (1997) (report of workshop on tropical forest indicators).

606. NAT'L RESEARCH COUNCIL, *supra* note 3, at 17.

607. The Heinz Center expects to publish a series of proposed indicators in 2002. The

recommendations by creating an administrative process for setting and maintaining indicators that will define the parameters of "normal" ecological change. There is no more important objective if we are to be able to distinguish between metastability of ecological systems and ecological collapse.[608] In addition, the United States government should cooperate with other countries and international institutions in systematic monitoring of worldwide ecological conditions.[609] The success of the International Panel on Climate Change is a model for cooperation among scientists worldwide that should be replicated in ecology.

3. Require Large-Scale Environmental Impact Analyses

One of the most contentious issues in environmental impact analysis under the National Environmental Policy Act[610] has been the extent to which the agency should take a broad look at impacts on large space and time scales.[611] Ecologists urge the making of land use decisions in a regional context.[612] Agencies, however, being usually short on funds and under pressure from constituents who are eager to see construction begin, typically like to reduce the scope of impact analysis to the extent possible. This reduction in scope has given rise to frequent litigation challenging the absence of analysis of cumulative and indirect impacts[613] and the failure to produce programmatic impact statements.[614]

Heinz Ctr., *The State of the Nation's Ecosystems* (Summer 2001), *available at* http://www.heinzctr.org/Programs/Reporting/overview.htm (last visited May 29, 2002). *See* Robin O'Malley & Kate Wing, *Forging a New Tool for Ecosystem Reporting*, 42 ENV'T (3) 20 (2000). *See also* Robert V. O'Neill et al., *Monitoring Environmental Quality at the Landscape Scale*, 47 BIOSCIENCE 513 (1997) (recommending use of remote sensing to monitor environmental quality).

608. Gretchen C. Daily, *Developing a Scientific Basis for Managing Earth's Life Support Systems*, 3 CONSERVATION ECOLOGY (2):14 (Oct. 27, 1999), *available at* http://www.consecol.org/vol3/iss2/art14 (scientists must establish "standard metrics and systematic monitoring of the magnitude and rates of change in human impacts on ecosystems").

609. Edward Ayensu et al., *International Ecosystem Assessment*, 286 SCI. 685 (Oct. 22, 1999) (urging creation of global ecosystem assessment).

610. 42 U.S.C. § 4331 (1994).

611. WILLIAM H. RODGERS, JR., ENVIRONMENTAL LAW 947-57 (2d Hornbook ed., 1994). For an interesting discussion of the role of geographic scale in environmental law, see Daniel A. Farber, *Stretching the Margins: The Geographic Nexus in Environmental Law*, 48 STAN. L. REV. 1247 (1996).

612. Dale et al., *supra* note 536, at 656.

613. RODGERS, JR., *supra* note 611, at 947-52.

614. Jon C. Cooper, *Broad Programmatic Policy and Planning Assessments under the National Environmental Policy Act and Similar Devices*: *A Quiet Revolution in an Approach to Environmental Considerations*, 11 PACE ENVTL. L. REV. 89, 123-36 (1993). *See* RODGERS, JR., *supra* note 611 at 936-41.

A classic example is found in a 2001 district court decision finding inadequate a group of environmental impact statements (EIS's) relating to the Sonoran pronghorn.[615] This antelope-like animal was once common in the Sonoran desert region, but it now is reduced to a few hundred individuals that occupy federal lands in Southern Arizona.[616] The lands it occupies are managed by a number of separate federal agencies: an Air Force bombing range, a national monument, a wildlife refuge, and lands leased for grazing by the Bureau of Land Management; thirteen federal agencies are involved in the management of these lands.[617]

Each of the federal agencies prepared its own EIS for the activities it was conducting or permitting on this complex of federal lands. The agencies were required to follow the regulations adopted by the Council on Environmental Quality, which require that, in explaining the environmental consequences of proposed actions under NEPA, an EIS discuss "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, . . . any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented,"[618] and the indirect[619] and cumulative effects[620] of the proposed action.

It was the cumulative effects issue that tripped up the federal agencies in Arizona. The Defenders of Wildlife argued that the various military activities on the Southern Arizona lands, together with activities of the border patrol, recreational users, and grazing lessees, adversely impacted the Pronghorn and that the EIS's prepared by the various federal agencies were inadequate because each EIS focused only on the activities of a single agency.[621] The court agreed, pointing out that the "Pronghorn move across this relatively discreet area of land entirely under federal management without regard to which federal agency is responsible for

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615. Defenders of Wildlife v. Babbitt, 130 F. Supp. 2d 121, 138-39 (D.C. Cir. 2001).

616. A NATURAL HISTORY OF THE SONORAN DESERT 487-90 (Steven J. Phillips & Patricia Wentworth Comus eds., 2000). The Sonoran pronghorn is a subspecies of the pronghorn, which is considered to be rare throughout its range in the Western United States. It is the sole surviving member of its taxonomic family and considered to be an evolutionarily isolated animal. Bruce A. Stein et al., *A Remarkable Array: Species Diversity in the United States*, *in* PRECIOUS HERITAGE: THE STATUS OF BIODIVERSITY IN THE UNITED STATES 55, 71 (Bruce A. Stein et al. eds., 2000).

617. *Defenders of Wildlife*, 130 F. Supp. 2d at 122-23.

618. Council on Environmental Quality Environmental Impact Statement, 40 CFR § 1502.16 (2001). This language comes directly from the statute itself. 42 U.S.C. § 4332 (C) (iv) and (v) (1994).

619. Council on Environmental Quality Terminology, 40 CFR § 1508.8 (b) (2001).

620. Council on Environmental Quality Terminology, 40 CFR § 1508.7 (2001).

621. *Defenders of Wildlife*, 130 F. Supp. 2d at 123-24.

administering a particular area."[622] It sent the matter back to the agencies with directions to coordinate their environmental analyses.[623]

In the light of decisions like these,[624] the need for cumulative impact analyses has begun to attract the attention of federal agency attorneys.[625] The EPA has also issued guidance on the application of environmental assessments to ecological processes,[626] which should make it easier for agencies to address cumulative ecological issues.[627] But it will take a distinct change of mind set to persuade most agencies to look at the issues from a larger perspective. The Council on Environmental Quality should amend its regulations to ensure that agencies cooperate in the preparation of environmental assessments on larger time and space scales. Alternatively, Congress should amend NEPA to prevent the agencies from fragmenting the environmental assessment into meaninglessness.[628]

4. Analyze the Environmental Impact of Inaction

The first generation of environmental laws, which still form the foundation of our environmental legislation, incorporated many features of static ecological thinking. Congress sought environmental stability: lakes and rivers were to be zoned for permanent uses; air quality was expected to reach specific and unchanging criteria; and the centerpiece of these environmental

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622. *Id.* at 129. The court also found that the biological opinions written under the ESA were inadequate for similar reasons. *Id.* at 125-31.

623. *Id.* at 138. For a discussion of the case, see William Snape III et al., *Protecting Ecosystems Under the Endangered Species Act: The Sonoran Desert Example*, 41 WASHBURN L.J. 14, 27-28 (2001).

624. For additional cases, see Natural Res. Def. Council v. Hodel, 865 F.2d 288 (D.C. Cir. 1988); Fritiofson v. Alexander, 772 F.2d 1225, 1243-46 (5th Cir. 1985); Muckleshoot Indian Tribe v. United States Forest Serv., 177 F.3d 800, 810-12 (9th Cir. 1999); Carmel-by-the-Sea v. United States Dep't of Transp., 123 F.3d 1142, 1151 (9th Cir. 1997); Nat'l Audubon Soc'y v. Butler, 160 F. Supp. 2d 1180 (W.D. Wash. 2001); Kettle Range Conservation Group v. United States Forest Serv., 148 F. Supp. 2d 1107 (E.D. Wash. 2001); Friends of the Earth v. United States Army Corps of Eng'rs, 109 F. Supp. 2d 30 (D.C. Cir. 2000); Defenders of Wildlife v. Ballard, 73 F. Supp. 2d 1094 (D. Ariz. 1999); Am. Lands Alliance v. Kenops, Civil No. 99-80-KI, 1999 U.S. Dist. LEXIS 13910 (D. Or. Aug. 30, 1999).

625. United States Army Legal Services Agency, *Environmental Law Division Notes: NEPA and Cumulative Impact Analysis*, 2001 ARMY LAW. 33, 35 (2001).

626. OFFICE OF FEDERAL ACTIVITIES, EPA, CONSIDERING ECOLOGICAL PROCESSES IN ENVIRONMENTAL IMPACT ASSESSMENTS (1999).

627. Robert L. Fischman, *The EPA's NEPA Duties and Ecosystem Services*, 20 STAN. ENVTL. L.J. 497 (2001) (advocating more quantification of ecological benefits in environmental assessment).

628. On the rather remote chances of Congress taking on the task of amending NEPA, see Paul S. Weiland, *Amending the National Environmental Policy Act: Federal Environmental Protection in the Twenty-first Century*, 12 J. LAND USE & ENVTL. LAW 275 (1997).

laws, the National Environmental Policy Act (NEPA),[629] sought to weigh prospective human activities against a "no action" alternative.[630]

Despite its non-substantive character, NEPA has continued to provide the framework for environmental impact analysis that dominates environmental planning. Court interpretations of NEPA have used federal action–not inaction–as the trigger, and the regulations have assumed that the least impact on the environment was the best. In other words, NEPA effectively created a presumption that doing nothing was the ideal alternative.[631] As one court put it, an environmental impact statement is not required "in order to leave nature alone."[632]

The assumption that inaction is desirable is so pervasive that only recently has it been questioned.[633] For example, EPA's guidelines for ecological risk assessment[634] fall into the pattern of assuming that any change is undesirable. Although EPA says that its ecological risk assessment process could be adapted to predict beneficial changes in ecological systems,[635] the guidelines as presently drafted make no provision for balancing beneficial ecological changes against adverse changes.[636]

But inaction can have an adverse impact on the ecology of an area just as surely as action can. A classic example is the San Bruno Mountain controversy that led to the 1982 amendments to

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629. 42 U.S.C. §4321 (2001). "NEPA was the first piece of federal legislation to raise ecology to primary status . . . . It rested on the premise that ecology could provide the rationale to guide administrative action." A. Dan Tarlock, *Biodiversity Federalism*, 54 MD. L. REV. 1315, 1326 (1995).

630. Council on Environmental Quality Environmental Impact Statement, 40 C.F.R. § 1502.14 (d) (2001).

631. *See* Note, *Does NEPA Require an Impact Statement on Inaction*, 81 MICH. L. REV. 1337, 1360 (1983).

632. Nat'l Ass'n of Property Owners v. United States, 499 F. Supp. 1223, 1265 (D. Minn. 1980), *aff'd*, Minnesota v. Block, 660 F.2d 1240 (8th Cir. 1981). For discussion of other cases involving the distinction between action and inaction, see Michelle Formy Duval, Recent Development, *Eighth Circuit Finds Decision to Discontinue Herbicide Use in National Forest Does Not Require an Environmental Impact Statement*, 4 S.C. ENVTL. L.J. 74 (1995); C.A. Gavilondo, Recent Development, Sabine River Auth. v. Dept. of Interior: *NEPA's Applicability to Federal Inaction*, 67 TUL. L. REV. 560 (1992).

633. "At best, ecosystems can be managed rather than restored or preserved, and management will become a series of calculated, risky experiments." Tarlock, *supra* note 629, at 1330. I have offered some ideas about adaptive management of natural resources in Fred Bosselman, *Adaptive Management and Intergenerational Equity*, 12 U. FLA. J.L. & PUB. POL'Y 311, 320-28 (2001).

634. *See* discussion *supra* notes 584-97.

635. "Although intended to evaluate adverse effects, the ecological risk assessment process can be adapted to predict beneficial changes or risk from natural events." Guidelines for Ecological Risk Assessment, 63 Fed. Reg. 26,846, 26,848 (May 14, 1998).

636. *See, e.g.*, Guidelines for Ecological Risk Assessment, 63 Fed. Reg. at 26,891 (discussing "recovery").

the ESA authorizing Habitat Conservation Plans. San Bruno Mountain is just south of San Francisco, within the boundaries of three different municipalities having varying attitudes toward development. Private land on the mountain is the home of an endangered butterfly. The habitat is deteriorating because of the invasion of exotic species and use by trespassers in off-road vehicles. The area is one of high environmental consciousness–Stanford and Berkeley are nearby.[637]

Developers and local environmental groups brought agencies together, formed a committee, and prepared a habitat plan. Its key features were that developers would build housing on 14% of critical habitat area and would donate over 80% of the habitat area to the county. The developers agreed to contribute $60,000 per year to the county for management, to be funded by impact fees and assessments. This fund was to be used to remove exotic vegetation and to fence and patrol the area to keep out intruders. The USFWS approved a permit based on the plan, then used the plan as the basis for an amendment to the statute, which the court subsequently used as support for upholding the permit in a suit brought by a dissident Berkeley group.[638]

The most significant feature of the plan was the active management component to keep out invading species and ATVs so that the net result of development was to enhance survival of species. At that time, the ESA did not force or even encourage private landowners to take affirmative actions that would help an endangered species.[639] Had the area simply been left alone, biologists believed that a rare butterfly occupying the area would have soon become extinct.[640] The habitat conservation planning process that grew out of this case[641] has recognized that positive management of the environment is often essential for the protection of rare species.[642]

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637. For a recent survey and history of the area, see Rasa Gustaitus, *Secrets of San Bruno Mountain*, 17 CA. COAST & OCEAN 7 (Spring 2001).

638. Friends of Endangered Species, Inc. v. Jantzen, 760 F.2d 976, **982-83** (9th Cir. 1985).

639. Barton H. Thompson, Jr., *People or Prairie Chickens: The Uncertain Search for Optimal Biodiversity*, 51 STAN. L. REV. 1127, 1156-61 (1999) (§ 9 of ESA offers no incentive for improvement of habitat).

640. For a more complete description of the San Bruno Mountain plan on which the amendments were based, see Lindell L. Marsh and Robert D. Thornton, *San Bruno Mountain Habitat Conservation Plan, in* MANAGING LAND USE CONFLICTS: CASE STUDIES IN SPECIAL AREA MANAGEMENT 114 (David J. Brower & Daniel S. Carol eds., 1987).

641. This type of interjurisdictional planning was a prototype of many similar efforts ongoing in what Joseph Sax has called the "new age" of environmental restoration. Joseph L. Sax, *The New Age of Environmental Restoration*, 41 WASHBURN L.J. 1, 1 (2001).

642. *See, e.g.*, Loggerhead Turtle v. County Council of Volusia County, 120 F. Supp. 2d 1005, 1015 (M.D. Fla. 2000).

University of California at Davis law professor Holly Doremus points out that "ecologists tell us that most areas dedicated to the preservation of nature cannot simply be left to their own devices, but will require active human management."[643] There are many parts of the United States in which active intervention is essential if ecological systems are to be protected.[644] Hawaii is a huge, sad case study of the need for positive actions to combat ecological collapse. The Hawaiian Islands are over 2000 miles from any continent or other islands of substantial size.[645] The islands grew from volcanoes rising out of the ocean,[646] so plants and animals had to reach the islands after traversing huge expanses of open water. As a result, many groups of plants and animals, including reptiles and conifers, for example, were never able to reach the islands in pre-human times.[647] The relatively small number of species that succeeded in reaching the islands found ways of adapting to the wide range of niches that evolved as the volcanic activity subsided and the environment became more hospitable.[648] Through "adaptive radiation," the original immigrants evolved into a wide range of plants and animals uniquely adapted to ecological systems specific to Hawaii.[649]

With the arrival of the Polynesians, who were the first human settlers in Hawaii, came pigs, dogs, chickens, rats, and lizards. Captain Cook and other sea captains brought cattle, goats, sheep, and horses. The mongoose was later introduced, as were more than 130 species of birds.[650] In addition, non-native plants were brought into the islands in great numbers. There were some 900 species of plants at the time Captain Cook landed. Since that time, another 870 non-native species of plants have become established and are reproducing in the wild.[651] Many of these species are highly

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643. Doremus, *supra* note 485, at 57.

644. The Everglades is a classic example. *Id.* at 61. In other countries, as well, such intervention is needed. *See* Z. Naveh, *Mediterranean Uplands as Anthropogenic Perturbation-dependent Systems and Their Dynamic Conservation Management, in* TERRESTRIAL AND AQUATIC ECOSYSTEMS: PERTURBATION AND RECOVERY 544, 548-50 (Oscar Ravera ed., 1991) (Complete cessation of human interference in nature reserves in the Mediterranean region has caused biological impoverishment).

645. SHERWIN CARLQUIST, HAWAII: A NATURAL HISTORY 81 (1970).

646. Christina Heliker, *The Volcanic Origin of the Hawaiian Islands, in* CONSERVATION BIOLOGY IN HAWAI'I 11, 11 (Charles P. Stone & Danielle B. Stone eds., 1989).

647. CARLQUIST, *supra* note 645, at 82.

648. ROBERT J. WHITTAKER, ISLAND BIOGEOGRAPHY: ECOLOGY, EVOLUTION, AND CONSERVATION 93-104 (1998).

649. CARLQUIST, *supra* note 645, at 122-38; Bruce A. Stein et al., *supra* note 616, at 89-92.

650. Charles P. Stone, *Non-Native Land Vertebrates, in* CONSERVATION BIOLOGY IN HAWAI'I 88, 88-91 (Charles P. Stone & Danielle B. Stone eds., 1989).

651. Clifford W. Smith, *Non-Native Plants, in* CONSERVATION BIOLOGY IN HAWAI'I 60, 60 (Charles P. Stone & Danielle B. Stone eds., 1989).

invasive, such as the Banana poka, lantana, and blackberry, and are crowding out native vegetation.[652]

Today, many of the native plants and animals of Hawaii have become extinct or are gravely threatened; for example, at least 77 endemic species of birds have become extinct since the arrival of the Polynesians.[653] The most serious issue facing native ecological systems in Hawaii is not action but inaction.[654] Removal of invasive exotic species of plants and animals is a constant and difficult undertaking[655] for which appropriations have been difficult to find.[656]

Is it feasible to apply the National Environmental Policy Act to inaction as well as action? In the absence of specific CEQ regulations, it is impossible to imagine judicial support for such an interpretation, given the obvious hostility of the current Supreme Court to the statute.[657] And the difficulties of creating a justiciable issue over whether inaction is the equivalent of action are considerable.[658]

But NEPA does contain general language authorizing federal agencies to undertake environmental assessments that go beyond the mandatory submission of EIS's for major federal actions required by section 102(2)(C).[659] It requires each agency to "identify and develop methods and procedures, in consultation with the Council on Environmental Quality, . . . which will insure that

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652. *Id.* at 63-65. For an overall review of the current status of Hawaii's ecology, see Lloyd L. Loope, *Hawaii and the Pacific Islands, in* UNITED STATES GEOLOGICAL SURVEY, STATUS AND TRENDS OF THE NATION'S BIOLOGICAL RESOURCES, *at* http://biology.usgs.gov/s+t/SNT/index.htm (last visited December 4, 2001).

653. COMM. ON SCIENTIFIC ISSUES IN THE ENDANGERED SPECIES ACT, NAT'L RESEARCH COUNCIL, SCIENCE AND THE ENDANGERED SPECIES ACT 31-32 (1995). Other estimates range from about 60 to over 100 species of birds lost in Hawaii. WHITTAKER, *supra* note 648, at 236.

654. Leonard A. Freed, *Extinction and Endangerment of Hawaiian Honeycreepers: A Comparative Approach, in* GENETICS AND THE EXTINCTION OF SPECIES 137, 151-55 (Laura F. Landweber & Andrew P. Dobson eds., 1999). For a comment criticizing the recent decision of the Ninth Circuit Court of Appeals in Nat'l Parks & Conservation Ass'n v. United States Dept. of Transp., 222 F.3d 677 (9th Cir. 2000) for failing to require a large scale examination of the problem of alien species invasion in Hawaii, see Comment, *NEPA and the Danger of Alien Species Introduction*, 42 JURIMETRICS 31 (2001).

655. For a description of the process of removing pigs from natural areas, see Kenneth Brower, *The Pig War, in* A WORLD BETWEEN THE WAVES 71 (Frank Stewart ed., 1992).

656. Faith Campbell, *The Appropriations History, in* BALANCING ON THE BRINK OF EXTINCTION 134, 139-43 (Kathryn A. Kohm ed., 1991).

657. RODGERS, JR., *supra* note 611, at 838-39.

658. The generality of NEPA's language makes it difficult to enforce it judicially in the absence of implementing regulations. Oliver A. Houck, *Is That All?: A Review of The National Environmental Policy Act: An Agenda for the Future, by Lynton Keith Caldwell*, 11 DUKE ENVTL. L. & POL'Y F. 173, 178-81 (2000) (book review).

659. 42 U.S.C. § 4332 (C) (1994); *see* Dinah Bear, *The Promise of NEPA, in* BIODIVERSITY AND THE LAW 178, 182-83 (William J. Snape ed., 1996).

presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations."[660] Many people, including the primary author of NEPA, have criticized the failure to use the statute to achieve more substantive environmental goals.[661]

The Council on Environmental Quality could and should adopt regulations encouraging some form of environmental assessment, although not necessarily the EIS required for major federal actions,[662] for those ecological problems that are suffering from inaction. Ecological science tells us that inaction in the face of impending ecological collapse is as fatal as any action. The difficulty of defining inaction should not be an excuse for failing to give it a try.

B. Focus on Post-Disturbance Reorganization

Governments need to think in advance about how they are going to react to the kinds of ecological disturbance that are likely to occur. They need to (1) think about what kind of disturbances are likely and how they will react to them; (2) manage the disturbance when it occurs, and (3) aid the reorganization process.[663] In some cases, it may be necessary to avoid the temptation to try to control the reorganization process too closely; often, the ecological systems will reorganize themselves effectively with little assistance.[664]

One business executive has said that managers need to plan like a fire department. The department "can't predict where the next fire will be, so it has to shape . . . [a] team that is capable of responding to the unanticipated,"[665] which often may require reversing earlier decisions.[666] The one area where the federal

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660. 42 U.S.C. § 4332 (B) (1994).

661. *See generally* LYNTON KEITH CALDWELL, THE NATIONAL ENVIRONMENTAL POLICY ACT: AN AGENDA FOR THE FUTURE (1998).

662. For suggestions on ways to limit inaction EIS's, see Note, *Does NEPA Require an Impact Statement on Inaction*, 81 MICH. L. REV. 1337, 1361-67 (1983).

663. Dale et al., *supra* note 543, at 550.

664. *Id.* at 551-52. *See, e.g.*, W.H. Van der Putten et al., *Plant Species Diversity as a Driver of Early Succession in Abandoned Fields: A Multi-site Approach*, 124 OECOLOGIA 91, 98 (2000) (querying whether sowing seeds of plants that usually occupy land at later stages of succession will speed up the succession process).

665. WILLIAM E. FULMER, SHAPING THE ADAPTIVE ORGANIZATION: LANDSCAPES, LEARNING, AND LEADERSHIP IN VOLATILE TIMES 139 (2000) (quoting Andy Grove).

666. James C. Scott, in his study of the failure of many international development programs, advocates a planning process that (1) takes small steps, (2) favors reversibility, (3) plans on surprises, (4) and assumes that future planners will be inventive. JAMES C. SCOTT, SEEING LIKE A STATE: HOW CERTAIN SCHEMES TO IMPROVE THE HUMAN CONDITION HAVE FAILED 345 (1998).

government appears to be succeeding in this effort is where it is, in fact, acting like a fire department.

1. Fire Policy

One result of large scale ecological research is a new attitude towards forest fires. A certain degree of forest fire activity is now seen as the kind of perturbation needed to preserve many forest systems.[667] For example, fires contribute to biodiversity by providing opportunities for the establishment and maintenance of early successional species.[668] But excessive fire can result in the permanent collapse of forest ecosystems.[669] When viewed on the spatial and temporal scale of an individual stand of forest to be harvested, any fire looks like a cataclysmic disturbance that should be eliminated.[670] But viewed on a spatial scale appropriate to the frequency of recurrence, fire can be seen as necessary to allow reorganization of the system.[671] For example, fire can often prevent the rapid transitions caused by invasive species.[672]

Traditional ecology thought of forests, like other ecological systems, as growing through cycles leading to "maturity."[673] In the early stages, the forest would be occupied by fast growing species that would subsequently be replaced by the longer lasting dominant

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667. R.V. O'NEILL ET AL., A HIERARCHICAL CONCEPT OF ECOSYSTEMS 167-69 (1986). *See* Norman L. Christensen, *Shrubland Fire Regimes and Their Evolutionary Consequences*, *in* THE ECOLOGY OF NATURAL DISTURBANCE AND PATCH DYNAMICS 85 (S.T.A. Pickett & P.S. White eds., 1985) (in old stands the net aboveground biomass accumulation approaches zero). Management of fire regimes has been complicated by their complex, chaotic nature, which limits the predictability of natural events and suggests the need for affirmative fire management. Christensen, Jr., *supra* note 543, at 179. Complexity is further increased when fire is compounded with other disturbances. Robert T. Paine et al., *Compounded Perturbations Yield Ecological Surprises*, 1 ECOSYSTEMS 535, 542 (1998). For an interesting analysis of the potential impact of fire management on climate change, see David Tilman et al., *Fire Suppression and Ecosystem Carbon Storage*, 81 ECOLOGY 2680 (2000).

668. John D. Stuart, *Effects of Fire Suppression on Ecosystems and Diversity*, *in* UNITED STATES GEOLOGICAL SURVEY, STATUS AND TRENDS OF THE NATION'S BIOLOGICAL RESOURCES (1999), *available at* http://biology.usgs.gov/s+t/SNT/noframe/lu107.htm (last visited Dec. 4, 2001).

669. For example, fire is being used in Southeast Asia as a land clearing mechanism, and the smoke has had a serious impact on air quality over long distances. Nicholas A. Robinson, *Forest Fires as a Common International Concern: Precedents for the Progressive Development of International Environmental Law*, 18 PACE ENVTL. L. REV. 459, 474-77 (2001).

670. The history of public attitudes toward fire is chronicled in STEPHEN J. PYNE, FIRE IN AMERICA (2d ed. 1997).

671. R.V. O'NEILL ET AL., A HIERARCHICAL CONCEPT OF ECOSYSTEMS 86 (1986). S*ee, e.g.*, Turner & Dale, *supra* note 342.

672. Mark W. Schwartz & Sharon M. Hermann, *Midwestern Fire Management: Prescribing a Natural Process in an Unnatural Landscape*, *in* CONSERVATION IN HIGHLY FRAGMENTED LANDSCAPES 213, 214-15 (Mark W. Schwartz ed., 1997).

673. *See, e.g.*, MARION CLAWSON, AMERICA'S LAND AND ITS USES 130-31 (1972).

species characteristic of the mature forest.[674] Today, ecologists typically view natural forests as intricate combinations of patches of different habitats of differing ages–the differences resulting from disturbances such as fire, disease, storms, etc.[675]

The ability to study forests over long time periods has led ecologists to view any ecological system that appears to be moving toward maturity as one that is becoming "overconnected" into an artificial manifestation of stability.[676] Thus forests that meet Clements' ideal of the climax may be most susceptible to fire and disease because at that stage, an ecological system is "an accident waiting to happen."[677] For example, the most easily accessible parts of the immense forests of Siberia have been clear-cut without any attempt at regeneration, but the great bulk of the forests are untouched and over-mature with many dead standing trees. Such forests are highly susceptible to fire, pests, and disease. In both clearcut and over-mature forests, the risk of a collapse and a flip to a new ecological system is great.[678]

Unlike most of the newer ecological ideas, the theory that disturbance can be beneficial has caught the public's attention ever

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674. Peter S. White & Jonathan Harrod, *Disturbance and Diversity in a Landscape Context*, *in* WILDLIFE AND LANDSCAPE ECOLOGY: EFFECTS OF PATTERN AND SCALE 128, 145-49 (John A. Bissonette ed., 1997).

675. NOSS & COOPERRIDER, *supra* note 194, at 183-86 (old growth forests are rich in species because of both vertical and horizontal heterogeneity). *See also* LEVIN, *supra* note 91, at 112 ("[L]ocal variability and heterogeneity provide the material for change;" disturbance and renewal maintain the diversity).

676. Charles D. Canham & P.L. Marks, *The Response of Woody Plants to Disturbance: Patterns of Establishment and Growth*, *in* THE ECOLOGY OF NATURAL DISTURBANCE AND PATCH DYNAMICS 197, 214 (S.T.A. Pickett & P.S. White eds., 1985) (even climax species depend on disturbances to complete their life cycle). If fire recurs frequently and regularly, it may no longer be appropriate to consider it a disturbance at all. Continued modification of the environment in response to fire leaves it with those species that resist fire or return quickly after fire; thus fire "has become incorporated into the system as a normal, working component . . . . The new system has evolved to an emergent, higher level of organization." AHL & ALLEN, *supra* note 124, at 170.

677. C.S. Holling, *Biodiversity in the Functioning of Ecosystems: An Ecological Synthesis*, *in* BIODIVERSITY LOSS: ECONOMIC AND ECOLOGICAL ISSUES 44, 65 (Charles Perrings et al. eds.,1995). *See, e.g.*, DAVID M. RIZZO & PATRICIA E. MALONEY, TAHOE RESEARCH GROUP, CAUSES AND PATTERNS OF TREE MORTALITY IN LAKE TAHOE BASIN FORESTS, *available at* http://trg.ucdavis.edu/research/annualreport/contents/forest/ article24.html (last visited May 29, 2002).

678. Sten Nilsson & Anatoly Shvidenko, Is Sustainable Development of the Russian Forest Sector Possible?, IUFRO Occasional Paper #11, ISSN 1024-414X. *See also* Ken Lertzman & Joseph Fall, *From Forest Stands to Landscapes: Spatial Scales and the Roles of Disturbances*, *in* ECOLOGICAL SCALE: THEORY AND APPLICATIONS 339, 354 (David L. Peterson & V. Thomas Parker eds., 1998) (explaining that unlike natural disturbance, clearcutting removes the complex post-disturbance structural diversity that is typical of patchy wildfires). *But see* F. Siegert et al., *Increased Damage From Fires in Logged Forests During Droughts Caused by El Niño*, 414 NATURE 437 (2001) (finding that selectively-cut forests in Borneo are most susceptible to destruction by fire during drought).

since the 1988 fires that swept in and around Yellowstone Park.[679] The severity of the fires was blamed on the National Park Service policy of extinguishing smaller fires and not clearing underbrush.[680] But by 2000, regrowth was well underway,[681] and the fires could be looked back upon as "just another chapter in a book whose pages keep turning."[682] Today, ecologists carefully analyze the relative benefits of forest restoration and prescribed burning on various types of habitat in the park.[683] The idea that fire is simply an ordinary part of the normal life cycle of forests and grasslands has become widely accepted.[684]

Seen at the scale of an individual forest or grassland fire, the chaotic behavior of fire regimes limits our ability to predict the behavior of any specific fire.[685] But on larger space and time scales, it is clear that natural fire regimes have played an important role in the development and maintenance of ecological systems.[686] Ecologists believe that an understanding of these fire regimes will help reestablish ecological processes after fires.[687] While paleoecology cannot yet give us detailed pictures of prehistoric fire patterns, we need to try to understand and simulate such conditions to the extent possible, given all of the other human resources that are impacted by fire.[688]

Government policy increasingly recognizes the need for fires, although the implementation of this policy near urban areas has

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679. A readable report of the fires and the condition of the burned areas a decade later is in MARY ANN FRANKE, YELLOWSTONE IN THE AFTERGLOW: LESSONS FROM THE FIRES (2000). The history of the ecological impact of fires caused by humans is summarized in Stephen J. Pyne, *Forged in Fire: History, Land, and Anthropogenic Fire, in* ADVANCES IN HISTORICAL ECOLOGY 42 (William Balée ed., 1998).

680. *See* MICHAEL FROME, REGREENING THE NATIONAL PARKS 169-71 (1992). A more careful analysis of the effects of National Park Service fire policy is found in Robert B. Keiter, *Preserving Nature in the National Parks: Law, Policy, and Science in a Dynamic Environment*, 74 DENV. U. L. REV. 649, 664-89 (1997).

681. Anthony D. Barnosky et al., *Temperate Terrestrial Vertebrate Faunas in North and South America: Interplay of Ecology, Evolution, and Geography with Biodiversity*, 15 CONSERVATION BIOLOGY 658, 668-69 (2001) (stating that Yellowstone sees replenishment by pre-existing and new species after each disturbance).

682. FRANKE, *supra* note 679, at 3.

683. *See, e.g.*, A. J. Hansen et al., *Spatial Patterns of Primary Productivity in the Greater Yellowstone Ecosystem*, 15 LANDSCAPE ECOLOGY 505, 519-20 (2000) (suggesting need to restore low-elevation cottonwood-aspen-fir forests in Yellowstone).

684. NOSS & COOPERRIDER, *supra* note 194, at 186-88 (1994) (noting that the species in any forest have adapted to a certain disturbance regime and that they are likely to be adversely affected by any alteration in that regime).

685. Christensen, Jr., *supra* note 543, at 179.

686. Schwartz & Hermann, *supra* note 536, at 213.

687. Virginia H. Dale et al., *Ecosystem Management in the Context of Large, Infrequent Disturbances*, 1 ECOSYSTEMS 546, 550 (1998).

688. Schwartz & Hermann, *supra* note 536 at 223.

been difficult.[689] The extensive fires in the Western United States in the year 2000 posed a real test for fire managers. The Interior and Agriculture Departments issued a report analyzing the response to these fires.[690] The report noted that the earlier policy of aggressive fire suppression appeared to be successful back in the 1970s, but it set the stage for today's intense fires:

> Species of trees that ordinarily would have been eliminated from forests by periodic, low-intensity fires began to become a dominant part of the forest canopy. Over time, these trees became susceptible to insects and disease. Standing dead and dying trees in conjunction with other brush and downed material began to fill the forest floor. The resulting accumulation of these materials, when dried by extended periods of drought, created the fuels that promote the type of wildfires that we have seen this year . . . .[691]

> In short, decades of aggressive fire suppression have drastically changed the look and fire behavior of Western forests and rangelands. Forests a century ago were less dense and had larger, more fire-resistant trees. For example, in northern Arizona, some lower elevation stands of ponderosa pine that once held 50 trees per acre, now contain 200 or more trees per acre. In addition, the composition of our forests have changed from more fire-resistant tree species to non-fire resistant species such as grand fir, Douglas-fir, and subalpine fir. As a result, studies show that today's wildfires typically burn hotter, faster, and higher than those of the past.[692]

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689. John D. Leshy, *The Babbitt Legacy at the Department of the Interior: A Preliminary View*, 31 ENVTL. L. 199, 205-206 (2001).

690. Protecting People and Sustaining Resources in Fire-Adapted Ecosystems--A Cohesive Strategy; Notice, 65 Fed. Reg. 67,479, 67,481 (Nov. 9, 2000).

691. SECRETARIES OF AGRIC. AND INTERIOR, MANAGING THE IMPACT OF WILDFIRES ON COMMUNITIES AND THE ENVIRONMENT: A REPORT TO THE PRESIDENT IN RESPONSE TO THE WILDFIRES OF 2000 (2000), *available at* http://clinton4.nara.gov/CEQ/firereport.html (last visited Sept. 27, 2001).

692. *Id*. The report also noted that because new development is occurring in fire-prone areas, often adjacent to Federal land, "firefighters today often spend a great deal more time and effort protecting structures than in earlier years. Consequently, firefighting has become more complicated, expensive, and dangerous." *Id*.

The federal agencies have recognized the important function that fire plays in forests and grasslands. They have responded to the buildup of fuels in forests and rangelands through a variety of approaches, including controlled burns,[693] the physical removal of undergrowth and other unnatural concentrations of fuel, and the prevention and eradication of invasive plants.[694] The report noted that the flammability of undergrowth has been augmented by invasive species such as cheatgrass, which is now common in the West. After a fire, "it grows earlier, quicker, and higher than native grasses. Then it dies, dries, and becomes fuel."[695]

The agencies emphasized that the program to reduce undergrowth was not an excuse to increase commercial logging:

> The removal of large, merchantable trees from forests does not reduce fire risk and may, in fact, increase such risk. Fire ecologists note that large trees are "insurance for the future –– they are critical to ecosystem resilience." Targeting smaller trees and leaving both large trees and snags standing addresses the core of the fuels problem.[696]

Following the issuance of the report, the Forest Service published a notice indicating that it planned to adopt a cohesive strategy for fire management and forest health programs.[697] The full text of the report was attached to the notice. The report relied heavily on large-scale ecological science in its conclusions.[698]

The report staunchly defends the application of large-scale ecological knowledge to the practical world of fire management. This is a major breakthrough in the promotion of adaptive management in the federal government. It remains to be seen whether a new administration will continue this emphasis on science.[699]

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693. The use of controlled burns goes back at least to 1975. *See* Paul F. Boucher & Ronald D. Moody, *The Historical Role of Fire and Ecosystem Management of Fires: Gila National Forest, New Mexico*, 20 TALL TIMBERS FIRE ECOLOGY CONFERENCE PROCEEDINGS 374 (1998).

694. SECRETARIES OF AGRIC. AND INTERIOR, *supra* note 691.

695. *Id*.

696. *Id*.

697. Protecting People and Sustaining Resources in Fire-Adapted Ecosystems–A Cohesive Strategy; Notice, 65 Fed. Reg. 67,480 (Nov. 9, 2000).

698. SECRETARIES OF AGRIC. AND INTERIOR, *supra* note 691.

699. Joe Grossman, *Blue Planet: Fire Plan Work Gets Mixed Reviews*, UPI SCIENCE NEWS, Sept. 12, 2001.

2. Remediation of Environmental Damage

Another area in which the management of natural resources needs to incorporate large-scale ecology is in the implementation of statutes dealing with cleanup of environmental damage caused by such things as hazardous waste and oil spills.[700] One of the more difficult issues in these processes has been the way in which the managers of the site should deal with the natural resources that were destroyed. Although the regulations impose significant obligations on polluters, some of the regulations' objectives seem to be based on outmoded ideas about ecological systems.

Congress required those who caused oil or hazardous waste pollution to pay the governmental agencies that manage natural resources for the damage such resources incur but left to the administrators the problem of drafting regulations defining such damage. In response to attempts during the Reagan administration to minimize the expense associated with non-economic issues, rules were proposed that gave minimal weight to resources that lacked significant economic value.[701] A strong backlash against these rules resulted in new rules that required restoration of the natural resources on each site. In 1997, the D.C. Circuit upheld most of the regulations implementing the natural resource damages sections of the Oil Pollution Act of 1990.[702] The regulations set restoration cost as the basic standard for measuring damages.[703] Although the earlier rules were ridiculously inadequate, and although damage to natural resources ought to result in stiff penalties,[704] the idea that restoration is the desirable approach may be inconsistent with today's awareness that ecological systems are continually changing.

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700. The primary examples are the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), Pub. L. No. 96-510, 94 Stat. 2767 (1980) (codified as amended at various places in 42 U.S.C.) and the Oil Pollution Act of 1990, 33 U.S.C. §§ 2701-61 (2000).

701. Ohio v. United States Dept. of the Interior, 880 F.2d 432, 438 (D.C. Cir. 1989). *See* James L. Nicoll, *The Irrationality of Economic Rationality in the Restoration of Natural Resources*, 42 ARIZ. L. REV. 463, 465-68 (2000) (regulations which allowed for damages to be set at the lesser of restoration costs or lost economic value were contrary to Congressional intent that "intended restoration to be the 'basic measure of recovery'").

702. Gen. Elec. Co. v. United States Dept. Of Commerce, 128 F.3d 767, 779 (D.C. Cir. 1997) (upholding damages based on restoration costs).

703. *See also* Kennecott Utah Copper Corp. v. United States Dept. of the Interior, 88 F.3d 1191 (D.C. Cir. 1996) (upholding similar regulations under CERCLA). *See* Dale B. Thompson, *Valuing the Environment: Courts' Struggles with Natural Resource Damages*, 32 ENVTL. L. 57, 84-87 (2002).

704. James Peck, Comment, *Measuring Justice for Nature: Issues in Evaluating and Litigating Natural Resources Damages*, 14 J. LAND USE & ENVTL. L. 275 (1999). For a comparative study of the approaches of different national legal systems to the issue of natural resource damages, see EDWARD H. P. BRANS, LIABILITY FOR DAMAGE TO PUBLIC NATURAL RESOURCES (2001).

This is particularly true in those areas in which the climate is changing rapidly, such as the Arctic.[705]

The Alaskan oil spill caused by the Exxon Valdez in 1989 offers a good example.[706] Although media attention focused on attempts to save individual creatures, ecologists recognized that saving habitat was the important objective.[707] As a result of the extended litigation that followed the accident,[708] damages paid by Exxon in the amount of $120 million have been put into a fund, the income from which is to pay for a "Gulf Ecosystem Monitoring Program," a long term monitoring and research program for the northern Gulf of Alaska.[709]

Nearly $700 million of Exxon's settlement with the state and federal governments has been used to purchase over half a million acres of land to preserve as parks and wildlife refuges.[710] However, the panel of scientists set up to monitor the Gulf Ecosystem

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705. WORKING GROUP 1, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, THIRD ASSESSMENT REPORT: SUMMARY FOR POLICYMAKERS 13 (2000).

706. The Exxon Valdez spill was clearly the catalyst for the Oil Pollution Act of 1990, which passed the Senate without a single dissenting vote, even though attempts to strengthen oil spill laws had foundered for years until then.:

> In an approximate way, the Exxon Valdez accident was the product of a combination of failures that included erratic navigation by an incapacitated captain in a vulnerable vessel under poorly planned conditions. In a long (ninety-one pages), comprehensive (amendments were made to nine different statutes), and detailed response, Congress spread solutions across this spectrum of navigation, operations, vessel condition, and planning. Behind the Oil Pollution Act of 1990 are a wide variety of human behavioral assumptions about bad-weather observations, upstart second-officers, clever programmers, casual use of the auto-pilot, aggressive engineers, and careful planners. But it is the specter of the drunken captain, personified as Joseph Hazelwood, that drove this legislative engine.

William H. Rodgers, Jr., *Where Environmental Law and Biology Meet: Of Pandas' Thumbs, Statutory Sleepers, and Effective Law*, 65 U. COLO. L. REV. 25, 66-67(1993) (footnote omitted). *See also* Deborah S. Bardwick, *The American Tort System's Response to Environmental Disaster: The Exxon Valdez Oil Spill as a Case Study*, 19 STAN. ENVTL. L.J. 259 (2000).

707. A volunteer who organized citizens to hand-scrub the oil off hundreds of otters and birds now looks back on this effort: "Exxon spent $80,000 per otter that survived the cleaning, but at least half of those are thought to have died soon after they were released. So it was closer to $160,000 per animal. I think that money would have been better spent restoring and protecting habitat." *Sea of Crude, Legacy of Hope*, SIERRA 81 (Mar./Apr. 1999). An interesting book by a person who worked on the cleanup process is JEFF WHEELWRIGHT, DEGREES OF DISASTER: PRINCE WILLIAM SOUND: HOW NATURE REELS AND REBOUNDS (1994).

708. Bardwick, *supra* note 706, at 262; Robert E. Jenkins & Jill Watry Kastner, Comment, *Running Aground in a Sea of Complex Litigation: A Case Comment on the Exxon Valdez Litigation*, 18 UCLA J. ENVTL. L. & POL'Y 151 (1999/2000)..

709. *Exxon Valdez* OIL SPILL TRUSTEE COUNCIL, GULF ECOSYSTEM MONITORING: GEM SCIENCE PROGRAM NRC REVIEW DRAFT 4, April 21, 2000.

710. FRED BOSSELMAN ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT 428 (2000). *See* Diane S. Calendine, Comment, *Investigating the* Exxon Valdez *Restoration Effort: Is Resource Acquisition Really Restoration?*, 9 DICK. J. ENVTL. L. & POL'Y 341 (2000).

Monitoring Program believe that it has shown little progress, that it is "moving toward a piece-meal, small-scale, project-driven approach," and that it "seems to be losing sight of its ecosystem focus as it selects individual species for attention."[711]

Could the habitats affected by the Exxon Valdez spill ever be returned to their original condition, given the volume of oil spilled and the area covered?[712] And given the rapidity of climate change in Alaska,[713] would it have been possible to recreate an environment that was created by different climate conditions? The World Wildlife Fund predicts that as much as 70% of the natural habitat of the Arctic could be lost by the end of the century.[714] Given these conditions, restoration makes sense only if we construe the term loosely.[715]

Lawmakers need to recognize the insights of large-scale ecology in implementing restoration of ecological systems.[716] Rather than simply succumbing to a nostalgia for what once existed, they need to try to create functioning ecological systems that will actually work in present conditions and that will support ecological processes equivalent to what was destroyed.[717] This requires an analysis of how ecological systems reorganize themselves in

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711. COMMITTEE TO REVIEW THE GULF OF ALASKA ECOSYSTEM MONITORING PROGRAM, NAT'L RESEARCH COUNCIL, INTERIM REPORT 28 (Feb. 2001). *See, e.g.*, Thomas A. Dean & Stephen C. Jewett, *Habitat-specific Recovery of Shallow Subtidal Communities Following the* Exxon Valdez *Oil Spill*, 11 ECOLOGICAL APPLICATIONS 1456, 1468 (2001) (stating that rocky shores recovered relatively quickly but soft sediment habitats remain impacted).

712. For an examination of recovery from two major oil spills in Europe, see Y. Le Moal et al., *Perturbation and Recovery After the Two Major Oil Spills (*Amoco Cadiz *and* Tanio*), in* TERRESTRIAL AND AQUATIC ECOSYSTEMS: PERTURBATION AND RECOVERY 417 (Oscar Ravera ed., 1991).

713. *See generally* NAT'L ASSESSMENT SYNTHESIS TEAM, U.S. GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE CHANGE IMPACTS ON THE UNITED STATES 283-312 (2001) (noting that extensive warming is predicted in Alaska).

714. Sarah Lyall, *A Global Warming Report Predicts Doom for Many Species*, N.Y. TIMES, Sept. 1, 2000, at A3. Public awareness of the warming of the Arctic was increased by reports that the ice has melted at the North Pole. Public attention was focused on the warming of the Arctic in the summer of 2000 when a scientific research team reported that there was open water, rather than ice, at the North Pole for the first time. John Noble Wilford, *Ages-Old Icecap at North Pole Is Now Liquid, Scientists Find*, N.Y. TIMES, Aug. 19, 2000, at A1.

715. Daniel Luecke of Environmental Defense says that ecosystem restoration should mean "The re-establishment of a balance in ecosystem structure and function to meet the needs of plants, animals, and human communities." Daniel F. Luecke, *An Environmental Perspective on Large Ecosystem Restoration Processes and the Role of the Market, Litigation, and Regulation*, 42 ARIZ. L. REV. 395, 396 (2000).

716. MUTSONORI TOKESHI, SPECIES COEXISTENCE: ECOLOGICAL AND EVOLUTIONARY PERSPECTIVES 274 (1999) (Except for fire, there has been little study in detail of the "characteristics and modes of operation of various forms of disturbance in a particular community on different spatio-temporal scales").

717. Alyson C. Flournoy, *Restoration Rx: An Evaluation and Prescription*, 42 ARIZ. L. REV.187, 195-96 (2000).

reaction to disturbance, so that such reorganization can be assisted and ecological collapse avoided. The regulations implementing the appropriate statutes should be examined to ensure that they reflect the current ideas of large-scale ecology.

C. Counteract Unidirectional Environmental Change

One corollary of the older Clementsian ecological theory was the idea that if we humans just stopped doing whatever "unnatural" things we were doing to an area it would eventually evolve back into its ideal climate condition. In other words, almost all human mistakes could be rectified by terminating them.[718] Needless to say, this has not proven to be the case, at least within time scales that we humans have experienced.[719] Large-scale ecology has shown us that many changes in the natural world are cyclical and that if we can keep these changes within normal parameters, the ecological systems should be resilient to these changes. But some of the changes humans are causing seem to be beyond the boundaries of any cycles that have occurred in the past.[720] Are these changes reversible?

1. Reversal

One such change is the increase of carbon dioxide in the air. Since accurate measurements of the amount of airborne carbon dioxide have begun, it has increased inexorably at the rate of 0.5% per year.[721] The overwhelming majority of serious scientists believe that the increase in emission of carbon dioxide and other greenhouse gases has contributed to the warming of the climate that has been taking place and that will continue at increasing rates throughout most regions of the United States.[722] Yet we are hesitant to expend resources on the reduction of greenhouse gas

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718. Furthermore, the emphasis put on stability, unique equilibria, and normative states [by the equilibrium theory] has historically promoted a view of a "benign Nature" able to cope with any sort of anthropogenic interference and manipulation, because trials (and errors) of any kind can be made with the assurance that recovery is always possible . . . .

De Leo & Levin, *supra* note 116.

719. Driving between the Allentown airport and my summer home in the Poconos, I pass through a valley that was the location of a Nineteenth-Century copper smelter. The barren landscape has experienced only minimal recovery a century later. For a description of the area, see BILL BRYSON, A WALK IN THE WOODS: REDISCOVERING AMERICA ON THE APPALACHIAN TRAIL 185-89 (1998).

720. *See* discussion *supra* notes 447-91.

721. GALE E. CHRISTIANSON, GREENHOUSE: THE 200-YEAR STORY OF GLOBAL WARMING 167 (1999).

722. COMM. ON THE SCIENCE OF CLIMATE CHANGE, NAT'L RESEARCH COUNCIL, CLIMATE CHANGE SCIENCE: AN ANALYSIS OF SOME KEY QUESTIONS 2 (2001).

emissions[723] because the lifestyle changes that would result from a program that would actually reverse the trend of carbon dioxide emissions[724] are staggering to contemplate.[725]

Similarly, despite our efforts to control water pollution in various ways, we seem to be steadily increasing the quantity of nutrients in coastal waters. A recent study suggests that the trend of increasing nitrate delivery by the Mississippi River to the Gulf of Mexico could be reduced by a 12% reduction of nitrogen fertilizer use in the river basin,[726] but the political inability to obtain cooperation from the sources of nonpoint source pollution makes it difficult to foresee an end to the steady growth of hypoxia in Gulf coastal waters, with its unforeseeable impact on the marine environment.[727]

The increase of carbon dioxide in the air and nitrogen in the water have not been dramatic, but they have been slow and steady.[728] The problems they create will increase year by year, burdening our descendants more with each generation, unless we

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723. *See generally* Symposium, *Innovations in Environmental Policy: The Psychology of Global Climate Change*, 2000 U. ILL. L. REV. 299 (2000).

724. James Hansen and some of his colleagues at NASA's Goddard Institute for Space Studies have published a paper that has attracted a great deal of attention: James Hansen et al., *Global Warming in the Twenty-First Century: An Alternative Scenario*, 97 PROC. NAT'L ACAD. SCI. U. S. 9875 (Aug. 29, 2000). They argue that trends in the emission of greenhouse gases other than carbon dioxide may be easier to control. They say that emissions of methane, the second biggest contributor to warming, may be easier and cheaper to reduce because efficient technology is available to reduce methane emissions significantly in regard to all of the major sources: rice cultivation, cattle raising, landfills, sewage treatment, pipeline leakage, and biomass burning. They also suggest that we can relatively easily reduce black carbon emissions from diesel fuel and coal, which have the effect of reducing cloud cover and thereby increasing warming. However, even if greater attention is paid to these new technologies the likelihood of short term reversal of greenhouse gas emission trends seems slight. *Id.*

725. For example, David Fleming, the director of the Lean Economy Initiative, a British environmental group, has proposed a system of "Domestic Tradable Quotas" that would allow the industrial economy to reinvent itself with a completely new way of meeting its energy needs. Every person would be given a Domestic Tradable Quota (DTQ), which would be an "equal per capita entitlement of 'carbon units' to cover domestic needs for fuel for all purposes, including private transport," and people could trade their units in the market. Over time, the total quantity of carbon units made available would be gradually reduced. Carbon units "would be surrendered–as 'virtual' ration coupons–to cover the purchase of all types of fuel and domestic energy." The greater the carbon emissions of the fuel or energy source, the more carbon units would have to be surrendered. "The whole transaction and all the calculations needed would be carried out using technology which is already commonplace for credit cards and direct debit systems." David Fleming, *Your Climate Needs You*, 67 TOWN & COUNTRY PLANNING 302 (Oct. 1998).

726. Gregory F. McIsaac et al., *Nitrate Flux in the Mississippi River*, 414 NATURE 166 (Nov. 8, 2001).

727. *See* discussion *supra* notes 492-512.

728. Most ecologists today would no longer support the idea that gradual change is always superior to rapid change because it provides more opportunity for adaptation, a view that was once popular. *See, e.g.*, RENÉ DUBOS, A GOD WITHIN 194-95 (1972).

can reverse the trends.[729] I am troubled by an assumption that my descendants will be able to solve ecological problems for which there is no historical precedent.[730] And as Holly Doremus has emphasized, the idea of ethical obligations to future generations resonates with a great many people, even including those without children of their own.[731] Programs to slow down these processes of unidirectional change have received some support at the national and international level,[732] and technological developments may provide new ways of coping with these issues efficiently,[733] but we would be kidding ourselves if we thought such programs or developments would avoid the need for both mitigation and adaptation to unidirectional change.[734]

2. Mitigation

Mitigation is the process by which the economic forces that drive environmental change are utilized to produce tradeoffs that

729. Why are we investing so little in solving long-range problems? Some people argue that our growing reliance on the stock market as the barometer of value is a major factor. The market encourages us to concentrate on quarterly results rather than long term prospects. Any corporate manager who proposes to sacrifice immediate gains for long-term investment runs the risk of being replaced or taken over. Consequently, managers "sometimes engage in activities counter-productive to the long-term interests of the company in order to 'meet their numbers.'" IRA C. MAGAZINER & ROBERT B. REICH, MINDING AMERICA'S BUSINESS: THE DECLINE AND RISE OF THE AMERICAN ECONOMY 193 (1982). Day trading and brokerage hype have added to this problem, as the long term investors who used to dominate the market have been joined by individual investors concerned primarily with short term swings in stock prices, and traditional pension plans that sought long-term securities are being replaced by plans that give employees the option of playing the market. *Everyone's Headache: Companies Wake Up to the Risks of Equity and Defined Benefit Schemes*, 361 THE ECONOMIST 8251 (Dec. 15, 2001).

730. *See* Bosselman, *supra* note 633, at 333.

731. Doremus, *supra* note 485, at 71-73.

732. The Kyoto Protocol, which is the international community's proposed answer to climate change, is insightfully analyzed in Lakshman Guruswamy, *Climate Change: The Next Dimension*, 15 J. LAND USE & ENVTL. L. 341 (2000).

733. Hydrogen-powered fuel cells, which would replace some fossil fuel-powered engines, are now receiving considerable attention. The Wall Street Journal said "not long ago, the fuel cell was dismissed as an environmentalist's pipe dream [but now] it is the subject of a heavily financed research-and-development race among some of the world's biggest auto makers." Jeffrey Ball, *Road Test: Automakers Are Racing to Market 'Green' Cars Powered by Fuel Cells*, WALL ST. J., Mar. 15, 1999, at A1. *See* Fred Bosselman, *Can Technology Reduce the Energy Cost of Sprawl*, 30 ENVTL. L. REP. 10,829 (Oct. 2000).

734. The Kyoto Protocol, which requires ratifying nations to severely reduce fossil fuel emissions, would only reduce the anticipated global temperature increase in 2050 from 1.4°C to 1.395°C if its goals were fully reached. Dale Jamieson, *Climate Change and Global Environmental Justice*, *in* CHANGING THE ATMOSPHERE, EXPERT KNOWLEDGE AND ENVIRONMENTAL GOVERNANCE 287, 304, (Clark A. Miller & Paul N. Edwards eds., 2001). In ecological time frames, global warming is likely to occur so quickly that changes in the ecosystem will lag several hundred years behind. FRANCES DRAKE, GLOBAL WARMING: THE SCIENCE OF CLIMATE CHANGE 209 (2000).

counteract the effects of such change.[735] One of the key recommendations of a recent National Research Council panel was to "explore prospects for mitigating these perturbations" by exploring the "feasibility and effectiveness of a variety of" technical and institutional approaches "for achieving sustainability of the essential nutrient cycles."[736]

The adoption of laws requiring environmental impact analysis has provided strong encouragement for the development of methodologies to quantify the relative environmental impacts of various alternatives.[737] Such quantification encourages the design of projects which produce an apparently favorable balance of impacts.[738] Numerous states followed the federal example and established state laws requiring environmental impact analysis.[739] Unlike the federal law, some of these state laws went further and required the showing of a positive environmental impact.[740] These statutes fostered a particular way of looking at environmental problems: focus on a particular development activity and tailor the regulation of that activity to insure that its beneficial impacts balanced or outweighed its adverse impacts.[741]

The concept of environmental mitigation was a logical outgrowth of this type of analysis. If a developer wanted to undertake a project that had adverse impacts on the environment, she could combine it with some other development activity, perhaps even wholly unrelated, that had a beneficial environmental impact,

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735. For a classification of potential trade-off mechanisms, see James Salzman & J.B. Ruhl, *Currencies and the Commodification of Environmental Law*, 53 STAN. L. REV. 607 (2000).

736. NAT'L RESEARCH COUNCIL, GRAND CHALLENGES IN ENVIRONMENTAL SCIENCES 20 (2001).

737. For an early example, see LUNA B. LEOPOLD ET AL., A PROCEDURE FOR EVALUATING ENVIRONMENTAL IMPACT (Geological Survey Circular 645, 1971).

738. *See* COUNCIL ON ENVTL. QUALITY, ENVIRONMENTAL IMPACT STATEMENTS: AN ANALYSIS OF SIX YEARS' EXPERIENCE BY SEVENTY FEDERAL AGENCIES 50-52 (1976).

739. See Donald G. Hagman, *NEPA's Progeny Inhabit the States - Were the Genes Defective?*, 7 URBAN L. ANN. 3 (1974).

740. *See* JAMES F. BERRY & MARK S. DENNISON, THE ENVIRONMENTAL LAW AND COMPLIANCE HANDBOOK 85-87 (2000).

741. A Florida statute establishing a procedure for the evaluation of developments of regional impact was of particular significance. Not only did it authorize the denial of development permission if the overall balance was found to be negative, it went significantly beyond the consideration of environmental factors to include the fiscal and economic considerations previously discussed. *See* JOHN M. DEGROVE, LAND, GROWTH AND POLITICS 119-20 (1984). The statute does not require quantification of impacts, and the Florida Supreme Court has expressly upheld the balancing of various factors without quantification, Graham v. Estuary Properties, Inc., 399 So. 2d 1374, 1377-78 (Fla. 1981), *cert. denied*, 102 S. Ct. 640 (1981), but the trade-off of positive and negative impacts has proven to be a key element of the process. *See* Gilbert L. Finnell, Jr., *Coastal Land Management in Florida*, 1980 AM. B. FOUND. RES. J. 303, 370-75 (1980); THOMAS G. PELHAM, STATE LAND-USE PLANNING AND REGULATION 49 (1979).

with the result that the balance tipped toward the favorable side.[742] Although mitigation sometimes incurs the wrath of environmental purists who brook no compromise, it has achieved widespread support from mainstream environmental organizations who see the opportunity to use the economic benefits generated by the development process as a source of funds for environmental protection that would not otherwise be forthcoming.[743]

Mitigation may be the best opportunity to cut back on some of the trends that we seem unable or unwilling to control by setting standards.[744] The idea that people who contribute to ecological collapse should bear the responsibility for mitigating the damage they create is a persuasive one.[745] But a recent study by the National Research Council found that the science and technology needed to mitigate damage to sensitive ecological systems such as wetlands must be based on large scale studies and planned on a regional basis.[746] The extensive efforts by industry to develop legal tradeoff systems to mitigate climate change is an example of efforts in that direction.[747]

3. Adaptation

Realistically, we can only hope to slow some of the future environmental change through reversal and mitigation. It will also be essential to adapt to environmental change in ways that reduce its adverse ecological impact to the extent possible. One way to do this is to develop programs that will better integrate natural ecological systems and the human environment. University of

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742. For a current look at the way mitigation often works, see Thomas J. Schoenbaum & Richard B. Stewart, *The Role of Mitigation and Conservation Measures in Achieving Compliance with Environmental Regulatory Statutes: Lessons from Section 316 of the Clean Water Act*, 8 N.Y.U. ENVTL. L.J. 237 (2000).

743. *See* Lisa A. Wainger et al., *Wetland Value Indicators for Scoring Mitigation Trades*, 20 STAN. ENVTL. L. J. 413, 414-15 (2001).

744. NAT'L RESEARCH COUNCIL, *supra* note 736, at 24.

745. For a discussion of the potential uses of biodiversity impact fees, see A. Dan Tarlock, *Local Government Protection of Biodiversity: What Is Its Niche?*, 60 U. CHI. L. REV. 555, 598-602 (1993).

746. NAT'L RESEARCH COUNCIL, COMPENSATING FOR WETLAND LOSSES UNDER THE CLEAN WATER ACT 45 (2001). The report suggests that the creation or restoration of ecological systems is much easier for some types of system than for others; for example, salt marshes and wet meadows are much easier to create or restore than shrub swamps and forested wetlands. *Id.* at 22-23. The report emphasizes the need for legal requirements and administrative enforcement to assure that required mitigation is monitored and enforced. *Id.* at 138-40.

747. JAE EDMONDS ET AL., PEW CENTER ON GLOBAL CLIMATE CHANGE, INTERNATIONAL EMISSIONS TRADING AND GLOBAL CLIMATE CHANGE ii-iv (1999). "Markets for environmental commodities represent the new wave of environmental protection and, despite critiques both subtle and shrill, they are still building." Salzman & Ruhl, *supra* note 735, at 609-10.

Arizona ecologist Michael Rosenzweig has come up with a name for this idea that has the potential of becoming the kind of sound bite needed to communicate in today's culture – reconciliation ecology.[748]

The goal of "reconciling" humans with the other species of the world is not new, of course, but Edward O. Wilson, the distinguished Harvard biologist who has initiated so many new scientific concepts, stimulated renewed interest in the idea with the publication of *Biophilia*[749] in 1984. His argument that an innate love of nature has evolved in humans through natural selection has been contentious, but it has stimulated a wide range of interest in further study of the psychological and sociobiological relationship between humans and other species.[750]

Rosenzweig, who is writing a book on reconciliation ecology, summarizes his analysis of the idea this way:

> For historical reasons, conservation biology has become mired in an attitude of confrontation: The green forces of nature versus the green forces of money. Conservation divides the world into pristine habitats and ruined habitats. It tries to save and restore the former while preventing further loss . . . .
>
> Science insists that area is an intrinsic property of natural ecosystems. To maintain their diversity, they must have their area. Thus, conservation biology has to address itself to the habitats in which human beings live, work, and play. Conservation biology has to learn how to share anthropogenic habitats with wild species. It needs to discover how to modify and diversify those habitats so that they harbor a wide variety of species. I call this sort of conservation biology reconciliation ecology.[751]

Conservation biology, which is an increasingly important applied science, has always recognized the need for studying the human element in biodiversity protection, as my colleague Dan Tarlock noted back in 1993: "Conservation biology is a true paradigm shift in resource management. It rejects the traditional

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748. Rosenzweig, *supra* note 533, at 5404.
749. WILSON, *supra* note 376.
750. *See, e.g.*, THE BIOPHILIA HYPOTHESIS (Stephen R. Kellert & Edward O Wilson eds., 1993).
751. Rosenzweig, *supra* note 533, at 5409. For excerpts from Rosenzweig's forthcoming book, see http://eebweb.arizona.edu/faculty/mlro/foot.html (last visited Jan. 5, 2002).

idea of resource preservation as fencing out humans to the maximum extent possible to isolate an ecosystem and replaces it with a view that recognizes the dynamic interaction between human settlement and natural systems."[752]

Holly Doremus argues that our current emphasis on nature reserves "can impede the development of a caring human relationship with nature," because it "suggests that human intrusion can only destroy nature." It is human contact with nature, she suggests, that is "essential to building the kinds of emotional connections that lead to political support for nature protection."[753] Our discourse

> should be as much about people as it is about nature. It should explain how people can fit into nature and fit nature into their lives. It should . . . focus on ways in which frequent contact with nature can make a difference to people, and make people different. It should acknowledge that nature can, and should, be found even in places heavily modified by human action.[754]

Ecological systems will continue to change in response to human modifications of the environment. The techniques of large-scale ecology will make us more aware of the nature of those changes, but the unprecedented nature of those changes will challenge the predictive abilities of ecological science. To the extent that we cannot fully reverse or mitigate these changes, we can adapt our

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752. Tarlock, *supra* note 745, at 567. A major obstacle to biodiversity protection "is that species increasingly are imperiled by highly dispersed, impersonal, untraceable human activities." J.B. Ruhl, *State and Local Government Vicarious Liability Under the ESA*, 16 NAT. RESOURCES & ENV'T 70, 77 (2001). *See also* Gretchen C. Daily, *Developing a Scientific Basis for Managing Earth's Life Support Systems*, 3 CONSERVATION ECOLOGY (2): 14, *at* www.consecol.org/Journal/vol3/iss2/art14/ (last visited Jan. 12, 2002).

753. Doremus, *supra* note 485, at 50-51. "If progress is to be made in the law of nature protection, the political discussion must more closely address the crux of the problem, asking how humans can live with and in nature." *Id.* at 63.

754. *Id.* at 64-65. Oxford biologist Robert May also suggests that too great an emphasis on ecosystem services could undermine biodiversity because:

> deeper knowledge of the rules governing ecosystem assembly could enable "ecosystem services" to be delivered in a world which was grievously biologically impoverished. The possibility that the world of the cult movie "Bladerunner" may be sustainable cannot be ruled out just because I – and probably you – would not wish to live in it.

ROBERT M. MAY, INTRODUCTION TO THE PRINCETON LANDMARKS IN BIOLOGY EDITION OF STABILITY AND COMPLEXITY IN MODEL ECOSYSTEMS xxv (2001).

activities to the maintenance of viable ecological processes most successfully if we make a conscious effort to do so.

V. CONCLUSION

The advances in ecological science that have made it possible to study the natural world over longer time spans and on larger geographic scales are sufficiently important that we should reexamine the laws regulating management of natural resources and environmental protection to incorporate today's best scientific knowledge. This requires that we obtain and distribute ecological information widely, that we use ecological assessment procedures and develop and monitor ecological indicators, that we require that environmental analyses be done on large scales, that we plan and manage natural resources with particular emphasis on management after disturbance, and that we give equal emphasis to the ecological problems caused by action and inaction. Above all, we must use all the means available to counteract the unprecedented, unidirectional changes that we are making to ecological systems.

NEW POWER, FEW NEW LINES: A NEED FOR A FEDERAL SOLUTION

HOANG DANG*

Table of Contents

I. INTRODUCTION

New power, few new lines.[1] This simple statement sums up the present situation facing the electricity industry as it moves from a highly regulated, monopolistic industry towards a deregulated, competitive one. According to the North American Electric Reliability Council (NERC), the electric transmission capacity in the United States is not keeping pace with the increase in electric generation.[2] The federal government, through the Public Utilities Regulatory Policy Act of 1978,[3] Energy Policy Act of 1992,[4] and

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1. "New power, few new lines" is a statement from an article published by the *Washington Post* commenting on the state of the electricity industry. Peter Behr, *For Operators, a Daily High-Wire Act*, WASH. POST, Aug. 22, 2001, at A1.

2. N. AM. ELEC. RELIABILITY COUNCIL, RELIABILITY ASSESSMENT 2001-2010 5 (2001).

3. Public Utilities Regulatory Act of 1978, Pub. L. No. 95-617, 92 Stat. 3117 (codified as amended in scattered sections of 16 U.S.C.).

4. Energy Policy Act of 1992, Pub. L. No. 102-486, 106 Stat. 2776 (codified as amended

Order No. 888,[5] successfully increased access to transmission lines, resulting in the rise of independent power producers.[6] However, this success has not come without a price. As more power is generated, more electricity is transferred along high-voltage transmission lines. This has placed a strain on the nation's transmission system and has resulted in transmission congestion, known as bottlenecks.[7] Consequently, the benefits of competition are negated by the inability of consumers to obtain the cheaper electricity.[8] Instead of lower prices, the retail price of electricity has actually increased in some areas of the country due to shortages and blackouts caused by the strain on the transmission grid.[9]

In response to this problem, the Federal Energy Regulatory Commission (FERC) issued Order No. 2000, encouraging the formation of regional transmission organizations (RTOs).[10] The FERC believes that transmission congestion is largely due to persistent discrimination by public utility monopolies reluctant to share their transmission lines with wholesale competitors.[11] Thus, RTOs will operate transmission facilities in a particular region, providing full and open access to all market participants in the region.[12] However, the FERC also realizes that construction of new transmission lines will have to occur in order to keep up with the increase in electricity generation.[13] Consequently, RTOs are responsible for the planning and expansion of transmission lines.[14]

Nevertheless, in order to truly provide RTOs with the mechanisms to expand the transmission system, federal jurisdiction over transmission must be expanded to allow the federal government to address the problems associated with expansion of the transmission grid. Electric transmission capacity is not keeping up with the increase in electric generation because utilities do not have the incentive to invest in the expansion of the transmission grid. In addition, state siting processes pose many barriers to any

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in scattered sections of 16 U.S.C., 25 U.S.C., 26 U.S.C., 30 U.S.C., and 42 U.S.C.).

5. FERC Order No. 888, 61 Fed. Reg. 21,540 (May 10, 1996) (to be codified at 18 C.F.R. pts. 35, 385).

6. *See infra* Part II.A.

7. Behr, *supra* note 1.

8. *Id*.

9. *Id*.

10. FERC Order No. 2000, 65 Fed. Reg. 810 (Dec. 20, 1999) (to be codified at 18 C.F.R. pt. 35).

11. Fred Bosselman, Jim Rossi & Jacqueline Land Weaver, Energy, Economics and the Environment 767, 771-73 (2000) [hereinafter ENERGY].

12. FERC Order No. 2000, 65 Fed. Reg. 810 (Dec. 20, 1999) (to be codified at 18 C.F.R. pt. 35).

13. ENERGY, *supra* note 11, at 773.

14. FERC Order No. 2000, 65 Fed. Reg. 810 (Dec. 20, 1999) (to be codified at 18 C.F.R. pt. 35).

attempt to construct an interstate transmission line. An attempt to construct transmission lines across state boundaries may be impeded by a state's ability to deny or delay approval for such construction. Under current law, the FERC is limited in its ability to solve such problems. States have exclusive jurisdiction over transmission siting, and the FERC has no authority under the Federal Power Act[15] to order the construction or expansion of transmission facilities, nor does it have authority to approve transmission siting.[16]

This paper argues that the Federal Power Act should be amended to authorize the FERC to both order the construction and expansion of the transmission grid and grant siting approval. However, the states' interests in protecting their citizens should not be ignored. Transmission siting certainly affects local communities, with respect to the health, safety, and environmental impacts of transmission lines. Thus, states should retain jurisdiction to determine whether the location of the transmission corridor is reasonable in relation to the local zoning laws, environmental regulations, and state comprehensive plans.

Section II describes the federal policy developments that have led to the increase in electricity generation, the strain this has caused on the transmission system, the FERC's response to the problem, and the current development of RTOs. Section III discusses federal and state jurisdiction in the area of transmission, examines some of the problems associated with interstate siting of transmission lines, and explores possible solutions. Section IV argues that states should work to improve their siting processes and that an amendment to the Federal Power Act, providing the FERC with increased authority over transmission, is necessary. Section V argues that increased federal authority over transmission siting is well within the powers of Congress under the Commerce Clause and Tenth Amendment.

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15. Federal Power Act, ch. 285, 41 Stat. 1063 (1920) (codified as amended in scattered sections of 16 U.S.C.).

16. Richard J. Pierce, Jr., *The State of the Transition to Competitive Markets in Natural Gas and Electricity*, 15 ENERGY L.J. 323, 330-33 (1994) (predicting that the allocation of jurisdictional power in the electric industry will prove to be a source of major problems to energy deregulation).

II. BACKGROUND

A. Federal Policy Developments

Historically, the electricity industry consisted primarily of investor-owned public utilities controlling all three components of the electricity industry: generation, transmission, and distribution.[17] The public utility enjoyed a monopoly within its designated service territory, but, in return, it had a duty to serve the members of the public in its service territory and was subject to extensive regulation by state regulatory authorities.[18] Today, however, the landscape of the electricity industry has changed significantly. Although there are still many vertically integrated utilities that control or own generation, transmission, and distribution facilities, there now exists many more independent power products concentrating only on the generation of electricity.[19]

Three federal policy developments were instrumental in increasing the number of independent power producers.:

1. PURPA

The Public Utilities Regulatory Act of 1978 (PURPA)[20] was instrumental in promoting competition in the generation of electricity because it led to an increase in the number of independent power generators. PURPA derived from the energy crisis of the 1970s and was designed to reduce the nation's reliance on foreign petroleum imports and stimulate the development of alternative sources of electricity.[21] Section 210 of PURPA authorizes the FERC to require utilities to purchase electricity from "qualifying facilities" (QFs). In addition, the FERC promulgated rules that encouraged the growth of QFs by requiring utilities to purchase power from QFs at a price known as "avoided costs," the costs at which a utility would have had to pay for electricity.[22] The result was that independent power producers enjoyed a competitive advantage because the utilities entered into long-term purchasing

17. ENERGY, *supra* note 11, at 659.
18. *Id.* at 146.
19. *Id.* at 718-19.
20. Public Utilities Regulatory Act of 1978, Pub. L. No. 95-617, 92 Stat. 3117 (codified as amended in scattered sections of 16 U.S.C.).
21. *See* Justin M. Nesbit, Note, *Commerce Clause Implications of Massachusetts' Attempt to Limit the Importation of "Dirty" Power in the Looming Competitive Retail Market for Electricity Generation*, 38 B.C. L. REV. 811, 815-16 (1997) (discussing the PURPA and EPAct's contribution to retail competition through open access of the transmission grid).
22. *Id.* at 816.

contracts with QFs at an "avoided cost rate" which exceed the utilities' "true avoided cost."[23]

2. Energy Policy Act of 1992

Another important piece of federal legislation is the Energy Policy Act of 1992 (EPAct), which authorizes the FERC to mandate wheeling for wholesale customers and suppliers (a public utility must transfer electricity along its transmission lines for the benefit of its competitors).[24] Although Sections 211 and 212 of PURPA authorize the FERC to mandate wheeling for wholesale customers and suppliers, the provisions were never fully utilized by the FERC due to narrow agency and judicial interpretations of the provisions.[25] The EPAct succeeded in clarifying and broadening the FERC's wholesale wheeling authority. This development was vital to the promotion of wholesale competition because independent power producers could now transmit electricity to its customers using the transmission lines of public utilities without having to own its own transmission lines.

3. Order No. 888

The FERC further increased access to transmission lines for independent power producers through Order No. 888. On April 24, 1996, the FERC issued Order No. 888, which required all public utilities that "own, control or operate facilities used for transmitting electric energy in interstate commerce to have on file open access non-discriminatory transmission tariffs that contain minimum terms and conditions of non-discriminatory service."[26] The order also required functional unbundling, whereby public utilities must take transmission services under the same tariff as their transmission customers; state separate rates for wholesale generation, transmission, and ancillary services; and rely on the same electronic information network that its transmission customers rely on to obtain information about its transmission system when buying or selling power.[27]

To facilitate open access transmission, FERC also issued Order No. 889 on the same day, which required utilities to participate in the Open Access Same-Time Information System (OASIS) electronic

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23. *Id*. at 816, 819-20.
24. *Id*. at 819.
25. ENERGY, *supra* note 11, at 719.
26. FERC Order No. 888, 61 Fed. Reg. 21,540 (May 10, 1996) (to be codified at 18 C.F.R. pts. 35, 385).
27. *Id*.

bulletin board system.[28] OASIS makes information regarding the availability of transmission capacity available to all customers to ensure that utilities do not unfairly deny access to their transmission facilities.[29]

B. The Results of Federal Policy Developments

Although these federal policy developments have been successful at promoting competition, the benefits of competition have yet to be fully realized by consumers. Increased wholesale competition was supposed to yield significant benefits to consumers in the form of lower retail prices for electricity. With increased competition in the wholesale market, it was projected that "retail prices for electricity would be reduced as much as 6 to 13 percent within 2 years" since customers could now buy electricity where it was cheapest and have it transmitted across long distances along the utilities' transmission lines.[30]

The actual results, in many parts of the country, are that the benefits of competition have been negated by the strain on the nation's system of interconnected high-voltage transmission lines.[31] "By 1990, non-utility generation [of electricity] had grown to supply more than half of the marginal generation capacity added to the industry, and more than 10% of cumulative generation capacity."[32] This increase in power means that significant transfers of electric power between regions are being conducted along the transmission grid. The transmission grid was not designed for this enormous increase in the flow of electricity and, as a result, problems have occurred in the form of transmission congestion, otherwise known as bottlenecks.[33] Transmission lines in certain parts of the country are often at full capacity and often exceed safety limits.[34] There exists an ever-present risk of power shortages and blackouts, which only cost consumers more money.[35] For example, "a brief power shortage [in New York City] led to a spike in prices that added an estimated $100 million to ratepayers' bills."[36] The results are that the benefits of competition have not been realized in many parts of the country. Transmission congestion denies consumers access to

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28. FERC Order No. 889, 61 Fed. Reg. 21,737 (May 10, 1996) (to be codified at 18 C.F.R. pt. 37).
29. *Id*.
30. ENERGY, *supra* note 11, at 717.
31. Behr, *supra* note 1.
32. ENERGY, *supra* note 11, at 719.
33. Behr, *supra* note 1.
34. *Id*.
35. *See id*.
36. *Id*.

cheaper electricity from distant suppliers and may increase electricity prices due to power shortages and blackouts.

C. The FERC's Response

In recognition of the growth of the electricity generation and the new stresses on the transmission grid, the FERC issued Order No. 2000, which provided for the formation of regional transmission organizations (RTOs) responsible for providing full and open access to all market participants in its region.[37] The FERC sought to ensure that customers realize the benefits of competition and believed that non-discriminatory open access transmission was the key to doing so. Order No. 2000 required all public utilities that own, operate, or control interstate transmission facilities to file with the FERC, by October 15, 2000, a proposal to participate in an RTO with the minimum characteristics and functions specified in the order or to describe the efforts it is taking to participate in an RTO.[38] The objective is for all transmission owning entities to turn over the control of transmission facilities to RTOs, which will operate such facilities and provide full and open access to all market participants in the region.[39]

An RTO approved by the FERC must contain four characteristics: (1) independence; (2) scope and regional configuration; (3) operational authority; and (4) short-term reliability. [40] FERC also requires eight minimum functions of an RTO: (1) tariff administration and design; (2) congestion management; (3) parallel path flow; (4) ancillary services; (5) OASIS and Total Transmission Capability and Available Transmission Capability; (6) market monitoring; (7) planning and expansion; and (8) interregional coordination.[41]

D. Development of RTOs

Although Order No. 2000 did not require the formation of RTOs, it did require that public utilities file plans for the formation of an RTO or, in the alternative, to file a statement describing their efforts to join an RTO, obstacles to participation, and plans to

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37. FERC Order No. 2000, 65 Fed. Reg. 810 (Dec. 20, 1999) (to be codified at 18 C.F.R. pt. 35).

38. *Id.* at 812.

39. *Id.* at 811; For an explanation of FERC Order No. 2000, see Susan N. Kelly & Debra H. Rednik, *FERC Gambles on Transmission: Will Order No. 2000 Spur Voluntary Formation of RTOS Nationwide?*, LEGAL TIMES, Apr. 24, 2000, at 29.

40. FERC Order No. 2000, 65 Fed. Reg. at 811.

41. *Id.*

participate in the future.[42] As a result, many public utilities in the country have already formed RTOs or are in the process of obtaining approval from the FERC for an RTO.[43] Although numerous RTO proposals exist, the FERC has definite plans for four large RTOs: one each in the West, Midwest, Northeast, and Southeast.[44] Some parts of the country are further along in the formation of RTOs than others. In the West, there already exists the California Independent System Operator, Desert STAR (covers the Southwest), and RTO West (covers the Pacific Northwest).[45] The FERC has encouraged Desert STAR and RTO West to merge. In the Midwest, two RTOs exist: the Midwest Independent System Operator and the Alliance Regional Transmission Organization.[46] In the Northeast, there are three RTOs: New York, New England, and PJM ISO.[47] Finally, the RTO proposals in the Southeast consist of GridSouth and GridFlorida. GridSouth currently consists of public utilities in North Carolina and South Carolina.[48] The Southern company, the parent company of utilities in Alabama, Georgia, Mississippi, and north Florida, proposed to create their own RTO, but the FERC denied their request, stating that it would have to join the already existing GridSouth RTO.[49] GridFlorida includes most of Florida, excluding the northwest Florida panhandle.[50] For the Northeast and Southeast regions, the FERC issued orders on July 12, 2001 for the utilities to enter into mediation for the development and implementation of a single RTO in each of those regions.[51]

III. TRANSMISSION EXPANSION AND CONSTRUCTION

The development of federal policy through PURPA, EPAct, and Order No. 888 has successfully increased competition in electricity generation, but very little has been done to expand the transmission

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42. *Id*. at 811-12.

43. For current information on the development of RTOs, see the FERC's website *at* http://www.ferc.gov.

44. FERC, REGIONAL TRANSMISSION ORGANIZATION ACTIVITIES, *at* http://www.ferc.gov/Electric/RTO/post_rto.htm (last visited Mar. 20, 2002).

45. *See FERC/RTOs: Slates October Rulemaking Workshops*, DOW JONES NEWSWIRE, Sept. 26, 2001, *at* http://www.dowjonesnews.com.

46. *Id*.

47. *See* Mirant Corp., *Northeast Power Markets: The Argument for a Unified Grid*, 139 PUB. UTIL. FORT. 36, 36 (2001).

48. Order Provisionally Granting RTO Status, FERC Docket No. RT01-74-000 (Mar. 14, 2001).

49. Bruce W. Radford, *News Digest*, 139 PUB. UTIL. FORT. 12, 14 (2001).

50. Order Provisionally Granting RTO Status, FERC Docket Nos. RT01-67-000 & RT01-67-001 (Mar. 28, 2001).

51. *See* Mediation Report for Southeast RTO, FERC Docket No. RT01-100-000 (Sept. 10, 2001); Mediation Report for Northeast RTO, FERC Docket No. RT01-99-000 (Sept. 17, 2001).

grid in order to meet the demands of increased competition. In the FERC's Notice of Proposed Rulemaking for Order No. 2000, the FERC recognized that the planning and construction of transmission lines are not keeping up with the nation's transmission requirements.[52] Furthermore, the North American Electric Reliability Council (NERC) has revealed that the nation's network of power lines is growing by less than one percent a year.[53] "Business is increasing on the transmission system, but very little is being done to increase the load serving and transfer capability of the bulk transmission system," says NERC.[54]

The FERC sought to change this statistic through the formation of RTOs, which will be responsible for the planning and expansion of transmission lines. However, RTOs are limited in their ability to actually expand transmission facilities.[55] The current structure provides utilities little incentive to invest in transmission lines.[56] Furthermore, state siting processes pose many barriers to an RTO's attempt to construct interstate transmission lines.[57] RTOs, of course, operate under the jurisdiction of the federal government and are subject to the regulatory authority of the FERC.[58] However, transmission line siting has traditionally been under the authority of states, many of which have delegated authority to local governments.[59] Through its power to regulate the certification and siting of transmission lines, states can impose barriers to an RTO's plans to expand the transmission grid.

Due to the many constraints on expansion of the transmission grid, there has been some support for turning over the siting authority to the federal government.[60] States, of course, are against any such proposal and argue that they should have exclusive jurisdiction over transmission siting because of its impact on local communities.[61] The National Association of Regulatory Utility Commissioners (NARUC), a non-profit organization composed of

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52. ENERGY, *supra* note 11, at 767, 773; Regional Transmission Organizations, 64 Fed. Reg. 31,390 (June 10, 1999) (to be codified at 18 C.F.R. pt. 35).

53. Behr, *supra* note 1.

54. Regional Transmission Organizations, 64 Fed. Reg. 31,390; ENERGY, *supra* note 11, at 773.

55. *See infra* Part III.A.

56. *See infra* Part III.B.1.

57. *See infra* Part III.B.2.

58. *See infra* Part II.A..

59. Pierce, *supra* note 16, at 333.

60. *E.g.*, Carl J. Levesque, *Stringing Transmission Lines, Untangling Red Tape*, 139 PUB. UTIL. FORT. 46, 51 (2001).

61. Ronald E. Russell, *Toward Federal / State Regulatory Harmony: Perspective of a State Regulator*, 9 CONN. J. INT'L L. 869, 873 (1994) (explaining the position of state regulatory commissions).

state regulatory authorities that regulate utilities, offered several alternatives to the current state of the law, many of which would allow states to retain exclusive jurisdiction over transmission siting but with additional components to address any disputes over interstate transmission siting.[62] However, it is unlikely that any solution to the problem will be effective without some federal preemption of state jurisdiction in the area of transmission siting.

A. Federal/State Jurisdiction over Transmission

Under current law, there exist a number of limitations on federal jurisdiction over transmission. Section 201 of the Federal Power Act (FPA), enacted in 1935, gives the Federal Power Commission (now the FERC) broad authority to regulate the rates, terms, and conditions of service for the "transmission of electric energy in interstate commerce and the sale of such energy at wholesale in interstate commerce."[63] However, states have historically exercised exclusive jurisdiction over transmission siting.[64] When Congress enacted the FPA, it intended to preserve the existing scope of state authority. Section 201 of the FPA states that "such Federal regulation, however, to extend only to those matters which are not subject to regulation by the States."[65] Thus, the Federal Power Act preserves state jurisdiction over transmission siting. Under current law, the FERC has no authority to order a utility to construct transmission facilities, nor can it authorize the construction and expansion of transmission facilities.

1. State Jurisdiction Over Transmission Siting

States vary greatly in the mechanisms used to approve transmission siting proposals, with the authority to site possibly resting with individual local governments, state environmental regulators, or state public utility commissions.[66] For those states that rest siting authority with local municipalities, the siting process is governed by local zoning laws and is adjudicated before courts, zoning hearing officers, boards of appeals, and local governing bodies. However, in other states, the siting process has

62. *Id*. at 878-79.
63. 16 U.S.C. § 824(a) (2001).
64. Pierce, *supra* note 16, at 333.
65. 16 U.S.C. § 824.
66. *See* Sager A. Williams, Jr., Comment, *Limiting Local Zoning Regulation of Electric Utilities: A Balanced Approach in the Public Interest*, 23 U. BALT. L. REV. 565, 598-99 (1994).

been consolidated into a one-stop permitting process that allows state authorities to preempt local governments.[67]

Preservation of state jurisdiction over transmission siting is important because states have a number of interests to protect with regard to transmission siting. Many state siting statutes were enacted in response to the environmental impacts of transmission lines and designed to effectuate a reasonable balance of the need for transmission lines against its health, safety, and environmental impacts.[68] Over the years, the possibility that transmission lines may cause adverse health effects has become a concern.[69] Several initial studies appeared to show a correlation between proximity to high-voltage transmission lines and cancer.[70] Since then, studies have produced conflicting results. One study published by the National Research Council found no evidence that the electromagnetic fields created by transmission lines cause cancer.[71] However, another study published by the National Institute of Environmental Health Studies found some potential correlation between electromagnetic fields and childhood leukemia.[72] Thus, for many landowners, transmission lines represent "locally undesirable land uses" (LULU) and face "not in my backyard" (NIMBY) opposition.[73]

For example, in *Frost v. Public Utility Commission of Texas*, several landowners opposed the Lower Colorado River Authority's proposal to construct a 345 kv line connecting two substations.[74] Approving the proposal, the state Commission found that the line would have a visual impact, but its effect on community values would be minimal.[75] The Commission considered that the transmission line skirted residential developments, avoided historical monuments, would not affect park and recreational areas, and that its route was environmentally sound.[76] These are just some of the many factors that state and local governments must take into account when siting transmission lines.

In addition, the siting of transmission lines must take into consideration the effect on the environment. For example, in

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67. *Id.* at 598.
68. *See, e.g.*, Transmission Line Siting Act, FLA. STAT. § 403.521 (2001).
69. ENERGY, *supra* note 11, at 676.
70. *Id.*
71. *Id.* (referring to NATIONAL RESEARCH COUNCIL, POSSIBLE HEALTH EFFECTS OF EXPOSURE TO RESIDENTIAL ELECTRIC AND MAGNETIC FIELDS (1997)).
72. *Id.*
73. *See* Williams, *supra* note 66, at 584-85, 598; *see also* Pierce, *supra* note 16, at 333.
74. 672 S.W.2d 883, 884 (Tex. App. 1984).
75. *Id.*
76. *Id.*

Florida Power Corp. v. Florida Department of Environmental Regulation, Florida Power Corporation (FPC) appealed the order of the Florida Department of Environmental Regulation (DER) rejecting its application for a wetland resource permit.[77] FPC sought the wetland resource permit so it could use 353.1 cubic yards of fill to support transmission poles.[78] DER rejected FPC's application because it found that the proposed transmission line would have adverse impacts.[79] The adverse impacts included: an impact on endangered and threatened orchids adjacent to the cleared corridor; disturbances to hydric soils and vegetation resulting from tree cutting, installation, and maintenance activities; and a permanent change in the character of the wetland, diminishing the overall productivity of the system and affecting wildlife utilization.[80]

B. Barriers to Transmission Expansion

RTOs are limited in their ability to make the necessary expansion to the transmission grid because the federal government has limited authority to eliminate the many barriers to transmission expansion.[81] Utilities have little incentive to invest in transmission expansion because it will only result in bringing in more competitors. In addition, approval for the siting of interstate transmission lines must be obtained from a number of different local governments, state agencies, and federal agencies, which may take years to accomplish. Furthermore, an RTO proposal to site transmission lines across several states can be thwarted by the denial of a permit by one state or, in some cases, by one local government.

1. Lack of Utility Incentive to Invest

It is widely agreed that one of the main reasons for the lack of construction and expansion of transmission lines is the lack of incentives for utilities to invest in transmission lines. In NERC's Reliability Assessment for 2001-10, it stated: "[u]nless mechanisms are developed to encourage investment in new transmission facilities and siting issues are addressed, few new transmission facilities and reinforcements will be constructed."[82] With the FERC's requirement of open and non-discriminatory access to

77. 638 So. 2d 545 (Fla. 1st DCA 1994).
78. *Id.* at 546.
79. *Id*. at 547.
80. *Id*.
81. *See infra* Part III.A.
82. N. AM. ELEC. RELIABILITY COUNCIL, RELIABILITY ASSESSMENT 2001-2010 5 (2001).

transmission lines, utilities wonder why they should build more transmission lines if it will only bring in more competition.[83] Following the issuance of Order No. 888, there was a drop in investment in new bulk transmission facilities of nearly fifty percent.[84]

2. Siting Issues

Another barrier to construction and expansion of transmission lines is the difficulty of siting transmission lines. The process can be extremely costly and time-consuming. Many state siting statutes require that its public utilities commission (PUC) determine that the construction or expansion of a transmission line is needed before approval will be granted.[85] A state PUC may have a difficult time justifying the construction of a transmission line solely designed for the benefit of wholesale electricity generators, who ultimately will transfer the electricity out of the state and have no duty to serve the residents of that state.[86] As NERC explains,

> if a line is going to go through three different states, the states on either end can demonstrate to their constituents what the benefits of that transmission line will be, but the state in the middle has a very difficult time demonstrating the benefit. So, it's almost impossible to get the line built and approved.[87]

As a result, a state public utilities commission will likely deny granting a certificate of need, which is the first requirement for obtaining approval for the construction of a transmission line.

States also have the power to hinder the construction of transmission lines by delaying approval.[88] In some states, the authority to site transmission lines is delegated to local governments through the application of local zoning laws.[89] If the construction of transmission lines is to extend across state boundaries, an RTO must obtain regulatory approval from both the local and state governments of multiple states. This process could

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83. Lawrence J. Spiwak, *You Say Iso, I Say Transco, Let's Call the Whole Thing Off*, 137 PUB. UTIL. FORT. 38, 39 (1999).

84. *Id*.

85. *See* Bruce W. Radford, *Electric Transmission: Do State Regulators Still Have a Voice?*, 137 PUB. UTIL. FORT. 42, 44 (1999).

86. *Id*.

87. Levesque, *supra* note 60, at 51 (quoting Tim Gallagher, manager of technical services at NERC).

88. Williams, *supra* note 66, at 596.

89. *See* Williams, *supra* note 66, at 598-99.

substantially delay construction and would be extremely costly. It is unlikely that any RTO will be willing to incur such costs. Under the Federal Power Act, the FERC does not have authority to authorize the construction or expansion of transmission lines.[90] Thus, the FERC would be powerless if a state sought to deny approval of the construction or expansion of transmission lines, and it would be powerless to expedite the permitting process.

C. Alternatives Proposed

Due to the many barriers a utility faces when siting transmission facilities across state lines, some would prefer turning over the siting process to the federal government.[91] Proponents argue that only having to deal with one federal entity will streamline the process and cut down on some of the delays.[92] Utilities will not have to deal with the numerous municipalities, counties, and states.[93] Of course, states assert that state regulatory commissions are in a better position to protect the public welfare of their citizens than federal regulators.[94] Federal preemption of state laws and local ordinances will ignore local concerns about adverse health effects, safety hazards, and environmental impacts of transmission lines.[95] Furthermore, a centralized federal process can also involve multiple federal agencies, including the U.S. Forest Service, Park Service, Army Corps of Engineers, and Department of Environmental Protection.[96]

The National Association of Regulatory Utility Commissioners (NARUC) has suggested six different solutions to the jurisdiction issue. In ascending order per the degree of federal preemption, the proposals are:

> Option 1: Exclusive state jurisdiction to certify the construction of transmission facilities within their respective borders.
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> Option 2: Exclusive state jurisdiction to certify the construction of transmission facilities within their respective borders plus a formal mechanism for resolving disputes.

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90. *See infra* Part III.A.
91. Levesque, *supra* note 60, at 51.
92. *Id.*
93. *Id.*
94. Russell, *supra* note 61, at 872.
95. *See id.* at 872-73.
96. Levesque, *supra* note 60, at 51.

> Option 3: Exclusive state jurisdiction to certify the construction of transmission facilities within their respective borders, but require that state decisions comply with federal siting standards.
>
> Option 4: Exclusive state jurisdiction to certify the construction of transmission facilities within their respective borders, but enact federal "antidiscrimination" legislation to enforce the Commerce Clause of the Constitution.
>
> Option 5: Creation of regional siting boards comprised of representatives from each affected state to displace individual state decision making.
>
> Option 6: Creation of federal siting authority with concurrent state jurisdiction.[97]

IV. ANALYSIS AND PROPOSAL

Given the needs of transmission expansion, it is unlikely that states can retain exclusive jurisdiction over transmission siting. Although states certainly have legitimate interests to protect, transmission siting has national ramifications. The expansion of the transmission grid is necessary to eliminate the transmission congestion plaguing many parts of the country. These national ramifications require a collaboration between state and federal authorities and further require states to cede some of their control over transmission siting to federal authorities. In fact, several state public utilities commissioners have recognized this requirement. Thomas Welch, Chairman of the Maine Public Utilities Commission, states "I don't think it's appropriate for states to be able to frustrate the creation of efficiencies that a broader market can achieve."[98]

A. Analysis of Alternatives Proposed

Merely retaining exclusive state jurisdiction but adding other mechanisms will not create a workable solution either. First of all, adding a mechanism for dispute resolution assumes that the courts or other dispute settlement authorities are equipped to resolve these

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97. Russell, *supra* note 61, at 878-89.

98. Carl J. Levesque, *Regulators' Forum: Can FERC and States Unite?*, 139 PUB. UTIL. FORT. 14, 20 (2001).

disputes. Often, it is not a matter of who is right or wrong but a matter of balancing local needs and regional needs. On the other hand, requiring states to comply with federal standards does not leave much in the area of state regulation. This is really complete federal preemption in the guise of state regulation. Third, adding "anti-discrimination" legislation may address the problem of protectionist actions by the states with regard to issuing certificates of need, but it does not address the problem of lack of investment in transmission expansion.

Fourth, the creation of regional siting boards assumes that states will be willing to participate in such a plan. There has been some support for the creation of regional siting boards. Two major electricity restructuring bills before Congress encompass such an idea.[99] These bills propose the creation of multi-state agreements to establish regional transmission planning agencies that will be responsible for coordinating the planning and siting of transmission facilities among the states.[100] Each participating state must vest in the regional transmission planning agency the authority that otherwise would be exercised by the state.[101] Cooperation among states is vital for the agreement to work since the proposal provides that decisions of the agency are made by majority vote.[102] Since the plan requires cooperation among states, the approval process can take just as long, if not longer, than if approval had to be obtained from each local and state government. Another problem is getting the states to enter into such agreements. States may not like the idea of placing the issue of transmission siting to a vote.

It is clear that some federal preemption in the area is needed. Therefore, the proposal to create a federal siting authority along with concurrent state jurisdiction is the best scenario. This proposal would follow along the lines of the Natural Gas Act, which allows the FERC to authorize the construction of natural gas pipelines.[103] One commentator has already proposed that the Federal Power Act be amended to allow the FERC the authority to preempt states and to authorize and order the construction of transmission lines just as it may authorize and order the construction of natural gas pipelines under the Natural Gas Act.[104] However, in order for such a proposal to work, the jurisdictional boundaries between federal and state governments must be specified.

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99. Comprehensive Electricity Competition Act, S. 1047, 106th Cong. § 302 (1999); Electric Consumers' Power to Choose Act of 1999, H.R. 2050, 106th Cong. § 111 (1999).

100. S. 1047 § 302; H.R. 2050 § 111.

101. S. 1047 § 302(c)(2)(C); H.R. 2050 § 111(c)(2)(C).

102. S. 1047 § 302(c)(2)(D); H.R. 2050 § 111(c)(2)(D).

103. 15 U.S.C. § 717(f) (2001).

104. Pierce, *supra* note 16, at 334.

B. Proposal

1. State Reform Measures

It is certain that an effective solution in this area will require collaboration between the federal government and state governments. On the states' part, states can certainly work to improve their own siting processes. States vary greatly in the mechanisms used to site transmission lines. For those states that have delegated the siting authority to local governments, approval for an interstate transmission line is extremely cumbersome. A utility would have to get approval from a number of municipalities, counties, and states. In addition, local governments are ill-equipped to take into account the statewide and regional needs for such a transmission proposal. For this reason, many states have consolidated the siting process into a one-stop permitting process that allows state authorities to preempt local governments.[105]

An example of such a statute is Florida's Transmission Line Siting Act (TLSA).[106] Before the enactment of the TLSA, Florida experienced many of the same problems that RTOs face today, where the siting of transmission lines required approval from several different agencies at the local and state level, making the approval process extremely costly and inefficient. In response, the Florida Legislature established a centralized and coordinated permitting process for the siting of transmission facilities by preempting any law, rule, regulation, or ordinance of the state or a political subdivision. The one-stop permitting process created by the TLSA sought to make the regulatory approval process more efficient and thus reduce the costs associated with transmission line siting.[107]

The TLSA provides that the Public Service Commission is responsible for determining the need for a transmission line upon a request by an applicant or upon its own motion.[108] This determination of need is required before any transmission line is approved under the TLSA. Upon the filing of a complete application, each agency affected by the proposed transmission corridor must file a report on how the proposed transmission corridor will impact matters within its jurisdiction, including an explanation of any permits, amendments, variances, or exemptions

105. Williams, *supra* note 66, at 598.
106. FLA. STAT. §§ 403.52-5365 (2001).
107. *See* Wade L. Hopping & Carolyn Songer Raepple, *A Solution to the Regulatory Maze: The Transmission Line Siting Act*, 8 FLA. ST. U. L. REV. 441, 441-44 (1980) (providing an in-depth look at the history, purpose, and operation of the Florida TLSA).
108. FLA. STAT. § 403.537(1)(a) (2001).

that will be required.[109] The Department of Environmental Protection must then prepare a written analysis of the application, which may include any conditions of certification it believes should be imposed.[110] The final stage is the certification hearing, in which evidence is presented before an administrative law judge. The certification hearing is to be conducted no later than 185 days after the complete application is filed.[111] The administrative law judge then prepares a recommended order within sixty days after the filing of the hearing transcript containing findings of fact, conclusions of law, and recommendations as to the conditions of certification.[112] The final decision to approve in whole, approve with modification, or deny rests with the siting board, which consists of the Governor and Cabinet. Within thirty days after receiving the recommended order, the siting board must make the final decision.[113]

Consolidating the siting process into a one-stop permitting process has many benefits. Substantial costs can be reduced because of the elimination of the multiple approval process. A utility proposing an interstate transmission project will only have to deal with a few state public utility commissions. In addition, delay in siting will be substantially reduced because the statute provides for specified time restraints on the siting process. The Florida TLSA provides a schedule for when certain steps must be taken. Consolidating the approval process with state authorities allows the state authorities to balance the impact of the transmission expansion against not only the local needs, but also the statewide and regional needs. Nevertheless, a consolidated siting process would not ignore local concerns. Local governments have ample opportunities to address their concerns during the process.

2. Federal Preemption

However, improvement in state siting processes is not enough to address the many problems associated with siting transmission lines. The one-stop permitting process may substantially reduce the delay and costs associated with siting, but it does not address the issue of unilateral decisions by states to deny certification due to a lack of demonstrated need for the transmission line in its state. Furthermore, state reform of the siting process does not address the

109. *Id*. § 403.526.
110. *Id*. § 403.526(3).
111. *Id*. § 403.527(2).
112. *See id*. § 403.527(3).
113. *Id*. § 403.529.

lack of investment in transmission expansion by utilities. To address this problem, it is clear that states must give up their authority to authorize transmission siting through the granting of certificates of public convenience and necessity. States should not be able to withhold approval of the construction of transmission lines based on a lack of need in their state since this has the effect of burdening interstate commerce. Such protectionist measures are a major impediment to the free flow of electricity.

Thus, the Federal Power Act should be amended to allow the FERC authority to order the construction and expansion of transmission lines and to issue certificates of public convenience and necessity. Allowing the FERC the authority to order transmission expansion would overcome the lack of investment by utilities in transmission expansion. Furthermore, allowing the FERC to issue certificates of public convenience and necessity overcomes any unilateral decision by states to deny approval of transmission siting based on a lack of need for transmission expansion in their state.

However, it is important for states to retain some of their jurisdiction in the area of transmission siting. Although the FERC is responsible for issuing certificates of public convenience and necessity, such approval should be conditioned on the proposal satisfying state siting standards. The location of the transmission line must still be reasonable in light of local zoning laws, environmental regulations, and state comprehensive plans. States should retain the authority to consider the proposed transmission line and determine how the transmission corridor will impact matters within its jurisdiction and to consider whether any permits, amendments, variances, or exemptions will be required.

V. CONSTITUTIONAL IMPLICATIONS

A federal statute that ultimately preempts state siting decisions and increases federal jurisdiction over an area traditionally under the control of states necessarily implicates constitutional issues in the area of the Commerce Clause and the Tenth Amendment. It is clear that under present law, the federal government does not have the authority to order the construction or expansion of transmission lines. States will likely argue against a statute that would allow the federal government to preempt state siting because the construction or expansion of transmission lines necessarily affects local communities. However, any challenge on Commerce Clause or Tenth Amendment grounds will likely fail due to the substantial effect construction or expansion of transmission lines has on interstate commerce.

A. Commerce Clause

Although states will be reluctant to turn over some of their control over transmission siting to the federal government, it is unlikely that an amendment to the Federal Power Act will be overturned on constitutional grounds. Under Article I, Section Eight of the United States Constitution, Congress has the authority to regulate commerce among the states or with foreign nations. The federal government's power to regulate under the Commerce Clause has been liberally construed by the Supreme Court. "[T]he commerce power extends not only to 'the use of channels of interstate or foreign commerce' and to 'protection of the instrumentalities of interstate commerce . . . or persons or things in commerce,' but also to 'activities affecting commerce.'"[114] Furthermore, the Court has stated that "it is difficult to conceive of a more basic element of interstate commerce than electric energy, a product used in virtually every home and every commercial or manufacturing facility."[115] Given the interstate aspects of the transmission of electricity, the statute will be upheld under the Commerce Clause so long as the statute demonstrates that it is rationally related to the congressional goal of eliminating barriers to interstate transmission siting.[116] Congress should have no problem with this given the relationship between the problems facing the electricity industry and what the statute will accomplish.

B. Tenth Amendment

Even if the statute is a valid exercise of Congress' power to regulate interstate commerce, another issue a state may raise is whether the Tenth Amendment restricts Congress' power to preempt transmission line siting. In the past, the Tenth Amendment had been read to be a nullity, adding nothing to the Constitution.[117] It was believed that so long as the regulation was within Congress' power under the Commerce Clause, the Tenth Amendment did not restrict Congress' power. However, there has been a recent re-emergence of Tenth Amendment jurisprudence that has limited Congress' power to regulate beyond Commerce Clause restrictions.

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114. FERC v. Mississippi, 456 U.S. 742, 754 n.18 (1982) (quoting a companion case decided the same day).

115. *Id*. at 757.

116. *Id*. at 757 n.22.

117. David T. Woods, Note, *A Step Toward Stability in Modern Tenth Amendment Jurisprudence: The Supreme Court Adopts a Workable Standard in* Printz v. United States, 42 ST. LOUIS U. L. J. 1417, 1420 (1998) (explaining the history of the Tenth Amendment).

1. Recent Tenth Amendment Jurisprudence

The re-emergence of the Tenth Amendment began with *National League of Cities v. Usery*, in which the Supreme Court held that the 1974 amendments to the Fair Labor Standards Act (FLSA) violated the Tenth Amendment.[118] The amendments expanded the FLSA's requirement of minimum wage and overtime pay for private sector employees involved in the production of goods for commerce to include all employees of the states and their subdivisions.[119] Although the Court conceded that minimum working conditions for employees had an impact on interstate commerce, the Court nevertheless held that "there are attributes of sovereignty attaching to every state government which may not be impaired by Congress, not because Congress may lack an affirmative grant of legislative authority to reach the matter, but because the Constitution prohibits it from exercising the authority in that manner."[120] Certain functions such as fire and police protection have been traditionally provided by the states and federal power cannot intrude on the states' freedom to structure integral operations in areas of traditional state government function.[121]

In 1985, in the case of *Garcia v. San Antonio Metropolitan Transit Authority*, the Court retreated from its previous decision and held the test under *National League of Cities* to be unworkable.[122] The case involved the application of the FLSA to transit authority employees, who argued that the setting of wages and hours for employees of the Transit Authority was a state government function and should not be intruded upon by the federal government.[123] The Court found that it was impossible to determine what was an integral and traditional function of state government and held that true protection of the states resides in the political process, thus overruling *National League of Cities*.[124]

Finally, in *New York v. United States*, the Court reestablished its commitment to the Tenth Amendment.[125] The case involved the Low-Level Radioactive Waste Policy Amendments Act of 1985, which provided three incentives for states to take responsibility for waste generated within their borders. Of the three incentives, the

118. 426 U.S. 833 (1976).
119. *Id*. at 837.
120. *Id*. at 845.
121. *Id*. at 845-52.
122. 469 U.S. 528, 546-47 (1985).
123. *Id*. at 533.
124. *Id*. at 546-47.
125. 505 U.S. 144 (1992).

Court held the take title provision to be invalid.[126] The provision required the states to either regulate according to the federal program or "take-title" to the waste.[127] The Court held that Congress can provide incentives, but it lacks the power to coerce or compel the states to require or prohibit any act.[128] Congress may not simply "commandee[r] the legislative processes of the States by directly compelling them to enact and enforce a federal regulatory program."[129]

2. Application of the Tenth Amendment

The problem found in the above cases is that a federal regulation sought to mandate states to implement a federal government program. It is unlikely that an amendment to the Federal Power Act, giving the FERC authority to order transmission expansion and to issue certificates of public convenience and necessity, would be held to violate the Tenth Amendment. Such a statute would not coerce or compel a state to implement a federal program, it would merely preempt the states in that area.

A similar program was analyzed by the Court in *FERC v. Mississippi*, in which the Supreme Court upheld parts of PURPA in the face of a Tenth Amendment challenge.[130] Section 210 of PURPA was challenged on the basis that it required states to enforce standards promulgated by the FERC in the development of cogeneration and small power facilities and authorized the FERC to exempt such facilities from state and federal regulations.[131] Insofar as Section 210 exempts qualifying facilities from state laws and regulations, the Court held that it is doing nothing more than preempting the states.[132] Preemption is valid so long as it is a valid exercise of the commerce power. The "Federal Government may displace state regulation even though this serves to 'curtail or prohibit the States' prerogatives to make legislative choices respecting subjects the States may consider important."[133] Thus, a statute that merely precludes states from regulating in the area is merely an exercise of federal preemption and not a violation of the Tenth Amendment.

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126. *Id*.
127. *Id*. at 152-53.
128. *Id*.
129. *Id*. at 161 (quoting Hodel v. Va. Surface Mining & Reclamation Ass'n, Inc., 452 U.S. 264, 288 (1981)).
130. 456 U.S. 742, 758-71 (1982).
131. *Id*. at 759.
132. *Id*.
133. *Id*.

In addition, the requirement of Section 210 that "each State regulatory authority shall, after notice and opportunity for public hearing, implement such rule . . . for each electric utility for which it has ratemaking authority," is simply requiring that the state adjudicate disputes arising under the statute.[134] The Court held that dispute resolution is a type of activity customarily engaged in by a state public service commission.[135] Therefore, this requirement was not a violation of the Tenth Amendment because it did not place any additional burdens on the states.

On a similar note, the proposal outlined here merely preempts states with regard to issuance of certificates of public convenience and necessity. The Court has held that preemption is valid so long as it does not violate the Commerce Clause. In addition, the proposal would not place any additional burdens on the states since states already have in place a permitting process by which they review transmission siting proposals. Therefore, it is unlikely that an amendment to the Federal Power Act will be overturned on Tenth Amendment grounds.

V. CONCLUSION

Transmission lines are vital to the implementation of the wholesale market for electricity. Although the construction and expansion of transmission lines has an impact on local concerns such as health, safety, and environmental impacts, transmission lines have an effect on residents of other states as well. Transmission congestion is a real and current problem, and the construction of more transmission lines is necessary to ensure that the transmission grid will be able to meet the needs of increased power. States will have a difficult time retaining exclusive control over an area that has such national and far reaching implications. Thus, an amendment to the Federal Power Act increasing the FERC's jurisdiction over transmission siting is necessary to eliminate the many barriers to transmission expansion.

134. *Id*. at 759-60.
135. *Id*. at 760.

NEGOTIATING THE MAZE: TRACING HISTORICAL TITLE CLAIMS IN SPANISH LAND GRANTS AND SWAMP AND OVERFLOWED LANDS ACT

SIDNEY F. ANSBACHER* & DR. JOE KNETSCH**

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I. INTRODUCTION

Two of the authors of this article previously published an article in this *Journal* describing the Public Trust Doctrine as applied to Florida's submerged sovereignty lands.[1] That article addressed a commonly addressed dichotomy in federal and Florida law: first, what are the public rights and government duties in submerged sovereignty lands? Second, what are those rights and duties in the lands that Florida received from the federal government under the Swamp and Overflowed Lands Act ("Lands Act")?[2] This article addresses a related issue, one which directly affects public and

* Member with Upchurch, Bailey & Upchurch, P.A., St. Augustine, Florida. B.A. University of Florida 1981; J.D. Hamline University 1985; L.L.M. University of Arkansas 1984.

** Historian for the Board of Trustees of the Internal Improvement Trust Fund, Bureau of Surveying and Mapping, Florida Department of Environmental Protection; B.A. Western Michigan University 1969; M.A. Florida Atlantic University 1974; Ph.D. Florida State University.

1. Sidney F. Ansbacher & Joe Knetsch, *The Public Trust Doctrine and Sovereignty Lands in Florida: A Legal and Historical Analysis*, 4 J. LAND USE & ENVTL. L. 337 (1989).

2. Act of Sept. 28, 1850, ch. 84.

private title throughout Florida: Spanish land grants. Particularly, what are the issues when a private person claiming title under a Spanish land grant has a boundary or title dispute against the State, which claims title under a Lands Act patent?

II. THE HISTORY OF TITLE CLAIM LAW

Spanish Civil law, of course, governed transactions in Spanish Colonial Florida. The United States' acquisition of Florida did not include lands Spain conveyed to private landowners, subject to conditions discussed below.[3] Lands Act conveyances from the United States to Florida, or from Florida to private grantees, were quitclaim transactions. If Spain had not conveyed those lands, then the United States took title to them upon its acquisition of Florida. Of course, if Spain had earlier conveyed the parcel, then the United States did not take title.

A. The Swamp and Overflowed Lands Act

The very nature and source of Lands Act title dictate the significance of this issue. A significant dichotomy exists between the State's original public trust duties in submerged sovereignty lands and in Lands Act lands. In *Coastal Petroleum Co. v. American Cyanamid Co.*,[4] the Florida Supreme Court clarfied that the State's public trust title in submerged sovereignty lands is so paramount that such lands could be conveyed under Lands Act patents or deeds only if they were specifically and expressly included in the instruments of title. This is consistent with Article X, Section 11 of the Florida Constitution, which provides that submerged sovereignty lands are held in the public trust, and may only be conveyed when the transaction would be in the public interest.[5]

Conversely, Congress passed the Lands Act to facilitate conversion and development of designated swamp and overflowed lands.[6] In 1841, congress granted 500,000 acres of land to certain states, as well as each new state on entry into the Union, for "internal improvement."[7] Florida acquired its 500,000 upon statehood in 1845 as a result of the Great Pre-emption Act of 1841.[8]

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3. PAUL W. GATES, PUBLIC LAND LAW REV. COMM'N, HISTORY OF PUBLIC LAND LAW DEVELOPMENT 87-105 (1968).

4. 492 So. 2d 339, 343-44 (Fla. 1986).

5. FLA. CONST. art. X, § 11.

6. Act of Sept. 28, 1850, *supra* note 2; ROY M. ROBBINS, OUR LANDED HERITAGE: THE PUBLIC DOMAIN, 1776-1970, 154-56 (2d ed., Univ. of Neb. Press 1976) (1942).

7. 43 U.S.C. § 857(1994).

8. I. B. Hilson, *Minutes of the Proceedings of the Board of Trustees of the Internal Improvement Fund of the State of Florida*, vol. 1, at VIII-XI (1902).

In 1850, Congress granted swamp and overflowed lands to various states under the Lands Act for that same purpose.[9] The U.S. Supreme Court directed that proceeds from conveyances of swamp and overflowed lands were to be applied to aid reclamation of those lands.[10] The state could use the proceeds otherwise *only* if the proceeds were not necessary to further reclamation.[11]

The methodology of selecting Swamp and Overflowed lands was fairly flexible and poorly administered from the national level, at the General Land Office, ("GLO"). The federal government allowed the states two main methods in order to select the lands to be designated Swamp and Overflowed. The most common, especially in the midwestern states, was to use the field notes of the Deputy Surveyors, in conjunction with the official plats, to choose the lands desired.[12] The second method, which Florida chose, was to appoint selecting agents to visit the lands, with field notes in hand, to make on-site selections and report them to the Governor and the Surveyors General.[13] In Florida, the first two surveyors asked to take on this task were Arthur M. Randolph and Henry Wells.[14] These men had been recommended to the Governor and sent into the field to make the appropriate selections. Randolph and Wells, prior to the Civil War, selected and approved to the State well over a million and one half acres.[15] The process for selecting such lands lasted from the 1850s through the turn of the Twentieth Century. The lands were selected by the agents, passed through an examination process by the Surveyors General's office and finally approved or rejected by the General Land Office.[16]

After the Civil War, the State again had agents in the field; however, as time went on, the lands selected were investigated by other surveyors, usually the County Surveyor from a neighboring county. Thus, in St. Johns County, the County Surveyor from Duval or Putnam County might have verified the selections of the agents of the State. Once these were approved by the Surveyors General's office, the selections were sent to the General Land Office and

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9. 43 U.S.C. §§ 982-983 (1994).
10. United States v. Louisiana, 127 U.S. 182, 191-92 (1888).
11. JOE KNETSCH, THE HISTORY OF FLORIDA SURVEYING 56-61 (2001).
12. *Id.* at 59.
13. *Id.*
14. *Id.*
15. *See* Rectangular File Box, *State Land Locations by Henry Wells and A. M. Randolph: File note, Wells' Long List* (on file with the Florida Department of Environmental Protection: Land Records and Title Section, Division of State Lands, Tallahassee, Fla.); Rectangular File Box, *Swamp Lands: Copy of Contract and Final Settlements Wells & Randolph* (on file with the Florida Department of Environmental Protection: Land Records and Title Section, Division of State Lands, Tallahassee, Fla.).
16. KNETSCH, *supra* note 11, at 59.

approved in the usual way.[17] The definition of Swamp and Overflowed lands was never clearly delineated by the federal government. Much confusion and many lawsuits resulted from this imprecision.[18]

Instructions to the Deputy Surveyors on the delineation of Swamp and Overflowed lands were often vague and nearly impossible to perform. The first instructions given in the General Instructions for 1855 declared:

> It may be that sometimes the margin of bottom, swamp or marsh, in which such uncultivatible land exists, is not identical with the margin of the body of land 'unfit for cultivation;' and in such cases a separate entry must be made for each opposite the marginal distances at which they respectively occur.[19]

Thus, the surveyor was personally required to segregate between lands into water, unfit for cultivation, and those that were high and dry. Such detailed work was not possible for surveyors under pressures of time, milage, and low costs. In some cases, the selecting agents asked for guidance as to the type of lands to be included in their lists, including lands in such areas as flat woods, where clay soils often held water for extended periods of time.[20] These, the General Land Office held, were proper for selection.[21] Also, most of the northern portion of the state had been surveyed by the time of the passage of the Lands Act, thus making the selection process more personal. All surveys were conducted in the dry season, so few of the areas surveyed reflected the actual High Water Line of navigable waterbodies.[22] Vague instructions, highly variable selection criteria and the impracticalities of many bureaucratic dictates made the administration of the Lands Act a difficult proposition at best.

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17. GLO Circular to Surveyors General (Nov. 21, 1850).

18. See discussions of the Swamp and Overflowed Lands Act in GATES, *supra* note 3, at 334-35; KNETSCH, *supra* note 11, at 56-61; ROBBINS, *supra* note 6, at 154-56.

19. KNETSCH, *supra* note 11, at 60 (quoting 1855 MANUAL OF INSTRUCTIONS FOR SURVEYORS).

20. Letter from A.M. Randolph & H. Wells, agents for the State of Florida, to B.A. Putnam, Surveyor General of Florida (July 5, 1852), in Letters and Reports for Surveyors General, Vol. 2:1847-56, at 831-32 (on file with the Florida Department of Environmental Protection: Land Records and Title Section, Division of State Lands, Tallahassee, Fla.).

21. Letters from Commissioner, Volume 6: 1850-52 (on file with the Florida Department of Environmental Protection: Land Records and Title Section, Division of State Lands, Tallahassee, Fla.).

22. KNETSCH, *supra* note 11, at 58.

Florida originally shared the Congressional intent to facilitate conversion and development. The first Florida Constitution expressly confirmed this:

> A liberal system of internal improvements, being essential to the development of the resources of the country, shall be encouraged by the government of this State; and it shall be the duty of the general assembly, as soon as practicable, to ascertain, by law, proper objects of improvement, in relation to roads, canals and navigable streams, and to provide for a suitable application of such funds as may be appropriated for such improvements.[23]

B. Internal Improvement Fund

The 1854 Florida Legislature created the Internal Improvement Fund to facilitate drainage and conversion of those lands the federal government conveyed to Florida.[24] The State used the term "swamp and overflowed lands" to justify the disposal and conversion of those lands.[25] That public interest argument contributed to the underlying rationale for the term "internal improvement trust fund."[26] The original act creating the Board of Trustees specifically designated three railroads and one canal company to be the immediate beneficiaries of the Internal Improvement Act.[27] This act, designed by David Levy Yulee and his allies in the Florida Legislature, was designed to make it easy for these ventures to acquire land from the State.[28] The rationale for this generous act was to attract people and money to Florida. In a state having over 35,000,000 acres and fewer than 200,000 people, this attitude was understandable. This was the same mentality that created the 1856 "Riparian Rights Act" to facilitate the development of commerce along Florida's navigable waterways.

Florida's Governor and Cabinet were appointed as, first, the Trustees of the Internal Improvement Fund, and, as later renamed, the Board of Trustees of the Internal Improvement Trust Fund

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23. FLA. CONST. art. XI, § 2 (1838, repealed 1868).
24. Fla. Laws 1854, ch. 610 (codified at FLA. STAT. § 253.001 (2001)).
25. Ansbacher & Knetsch, *supra* note 1, at 348 n.91 (citing J. ROTHCHILD, UP FOR GRABS: A TRIP THROUGH TIME AND SPACE IN THE SUNSHINE STATE 26-27 (1985)).
26. *Id.*
27. Fla. Laws 1855, ch. 610.
28. *Id.*

("Trustees").[29] Until 1913, the Trustees fostered management and sale of swamp and overflowed lands that they owned:

> Railroad development was the first phase, beginning with the very statute that created the Internal Improvement Fund . . . . [S]ome 1,100 miles of railway were built, for which the Trustees granted land premiums totalling slightly more than 9,000,000 acres. In addition, the federal government granted as further encouragement 2,220,000 acres from the Public Domain. These various grants combined amounted to a full third of all the land area in the state [which is about 34,000,000 acres], an average of about 10,000 acres for each mile of railroad constructed.
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> By the 1880's [there was] a shift of interest to the second broad phase of Trustee operations: drainage and land reclamation. . . . [I]n 1881 . . . 4,000,000 acres were sold into private ownership for reclamation purposes . . . . In addition . . . the Trustees conveyed some 2,780,000 acres of land to private companies as a premium for various waterway improvements.[30]

Many counties, prior to the passage of the 1913 Act, also incorporated many corporations for the exploitation of Florida's natural resources.[31] These were frequently granted extensive powers such as the building of tramways, deepening of navigable waters, dredging out swamps, creating canals, constructing roads, etc. In many of these incorporations, the counties were acting in direct violation of State powers and recent Florida Supreme Court

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29. Glenn J. MacGrady, Note, *Florida's Sovereignty Submerged Lands: What are They, Who Owns Them and Where is the Boundary?*, 1 FLA. ST. U. L. REV. 596, 603 (1973).

30. *Id*. at 604 n.51 (quoting Joel Kuperberg, Statement to the ELMS Committee (Sept. 14, 1972)).

31. For an example of one such community, see Joe Knetsch, *The River Town of Chatterton*, AT HOME: CITRUS COUNTY HIST. SOC'Y (Citrus County Historical Soc'y, Inverness, Fla.), Mar./Apr. 1998, at 9.

decisions, such as the 1893 *State v. Black River Phosphate Co.*[32] decision.

Florida's water law regulation during this period shows the pervasiveness of the "improvement mindset." The first Florida water regulation laws were the "ditch and drain" laws of 1893.[33] The State originally regulated water to control and impound excess flow.[34] The laws authorized counties to "build drains, ditches or watercourses upon petition of two or more landowners."[35] The 1901 legislature also authorized counties to reclaim lands on private initiative based on findings that reclamation would benefit agriculture or public health.[36]

C. Water Law Regulation

Beginning in 1913, however, the legislature incrementally granted the Trustees additional authority to protect sovereignty submerged lands below navigable waters.[37] As opposed to swamp and overflowed lands, sovereignty submerged lands have always been subject to the Public Trust Doctrine.[38] "The Public Trust Doctrine obligates a state government to act as trustee of the public interest in all public lands and waters in that state."[39] While the Trustees originally took title to swamp and overflowed lands subject to a congressional edict to develop them, Professor Joseph Sax summed up the Public Trust title in submerged sovereignty lands as follows:

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32. 13 So. 640 (Fla. 1893). In *Black River Phosphate Co.*, the Florida Supreme Court held that the Florida Riparian Act of 1856, which gave riparian property owners the title to lands above the channel, did not convey any associated right to mine phosphates from the beds of those adjacent navigable waters. *Id.* at 653. The court cited *Black River Phosphate Co.* in West Palm Beach v. Board of Trustees, 746 So. 2d 1085 (Fla. 1999), in holding that exceptions to public trust title in submerged lands are to be narrowly construed. *See also* the incorporation laws for various counties, e.g. Citrus, Hernando, Marion, etc.

33. *See generally* Act of June 2, 1893, ch. 4178, 1893 Fla. Laws 106; *see also* Sidney F. Ansbacher & Doug Brown, *A Proposal for Regional Water Management Districts to Regulate Consumptive Water Use in Minnesota*, 10 HAMLINE J. PUB. L. & POL'Y 235, 245 (1989).

34. *Id.*

35. *Id.* (citing Act of June 2, 1893, ch. 4178, 1893 Fla. Laws 106).

36. *See* Act effective May 31, 1901, ch. 5035, 1901 Fla. Laws 188.

37. MacGrady, *supra* note 29, at 604. Ironically, the 1913 act authorized the Trustees to convey islands and other property that was not adjacent to any privately owned riparian lands. *See* Act effective June 5, 1913, ch. 6451, 1913 Fla. Laws 122. This act led, unsurprisingly, to further development of, and off of, barrier islands. *Id.*

38. Ansbacher & Knetsch, *supra* note 1, at 346.

39. *Id.*

> When a state holds a resource which is available for the free use of the general public, a court will look with considerable skepticism upon *any* governmental conduct which is calculated *either* to reallocate that resource to more restricted uses *or* to subject public uses to the self-interest of private parties.[40]

Even after 1913, the Florida legislature promulgated many water laws that fostered conversion of what are today called wetlands. The General Drainage Act authorized the majority of landowners or the owner of the majority of lands in an area to file a petition, asking a circuit court to declare a drainage district.[41] The only requirement for state notification was the filing of a plan and the circuit court declaration with the Secretary of State's office.[42] The Trustees, whose sovereign lands might have been affected by the actions of these drainage districts, were not notified of the districts' creation at any time.[43] For example, following the federal government's 1956 amendment of the Watershed Protection and Flood Prevention Act of 1954,[44] the Florida Legislature passed the 1957 Florida Water Resources Act.[45] The 1957 Florida Water Resources Act created an agency within the Florida Board of Conservation to issue permits for "the capture, storage and use" of excess surface and ground water.[46]

III. FEDERAL STEPS TOWARD WETLAND PROTECTION

Gradually, however, the federal and then the state governments, began protecting wetlands. In 1967, the Secretary of the Interior and the Secretary of the Army signed a Memorandum of Understanding allowing the Department of the Interior to comment on Army activities.[47] *Zabel v. Tabb*[48] was the landmark federal case that established Army Corps regulation to block a dredge and fill project even if there was no impact on navigation. In *Zabel*, two landowners sought a dredge and fill permit to build a trailer park, with a bridge or culvert, on their lands along the Boca Ciega Bay on the Gulf Coast

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40. Joseph L. Sax, *The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention*, 68 MICH. L. REV. 471, 490 (1970).

41. Act effective June 9, 1913, ch. 6458, 1913 Fla. Laws 184, 184-86.

42. *Id.* at 185-86.

43. *See id.*

44. ch. 1027, §§ 2-7, 70 Stat. 1090 (1956) (codified as amended at 16 U.S.C. §§ 1001-1012 (2000)).

45. Act effective June 18, 1957, ch. 57-380, § 8(1)(a), 1957 Fla. Laws 855, 858.

46. *Id.*

47. *See* Zabel v. Tabb, 430 F.2d 199, 210-11 n.21 and accompanying text (5th Cir. 1970).

48. *Id.* at 200-01.

of Pinellas County.[49] The Fifth District reversed a summary judgment for the landowners holding that the denial was consistent with federal authority to prohibit a project on private riparian submerged lands in navigable waters:

> The starting point here is the Commerce Clause and its expansive reach. The test for determining whether Congress has the power to protect wildlife in navigable waters and thereby to regulate the use of private property for this reason is whether there is a basis for the Congressional judgment that the activity regulated has a substantial effect on interstate commerce. That this activity meets this test is hardly questioned. In this time of awakening to the reality that we cannot continue to despoil our environment and yet exist, the nation knows, if Courts do not, that the destruction of fish and wildlife in our estuarine waters does have a substantial, and in some areas a devastating, effect on interstate commerce . . . . Nor is it challenged that dredge and fill projects are activities which may tend to destroy the ecological balance and thereby affect commerce substantially. Because of these potential effects Congress has the power to regulate such projects.[50]

The *Zabel* court held that the Fish and Wildlife Coordination Act[51] and the National Environmental Policy Act[52] "spectacularly revealed" a "government-wide policy of environmental conservation."[53] The court analyzed the Memorandum of Understanding between the Secretaries of the Army and Interior, along with other evidence, as having "almost a virtual legislative imprimatur . . . to protect estuarine areas . . . ."[54] Finally, the court cited a House of Representatives report, which cited the lower court's permit denial as an example of the Army Corps' ability to evaluate ecological factors in review of a River and Harbors Act permit application.[55] In sum, *Zabel* held that the overwhelming weight of legislative evidence

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49. *Id.* at 201-02.
50. *Id.* at 203-05 (citations omitted).
51. 16 U.S.C. §§ 661-666 (2001).
52. 42 U.S.C. §§ 4331-4347 (2001).
53. *Zabel*, 430 F.2d at 209.
54. *Id.* at 211.
55. *Id.* at 214 n.27.

supported the Army Corps' denial of the permit for environmental reasons.[56]

A. Clean Water Act

The Clean Water Act ("CWA") was enacted in 1972 to regulate water pollution.[57] The CWA has largely superseded the River and Harbors Act as to wetlands regulation. Section 404 of the CWA regulates dredge and fill.[58] While the CWA's language was ambiguous as to whether its jurisdiction reached beyond navigable waters,[59] the District Court for the District of Columbia concluded in Natural Resources Defense Council, Inc. v. *Callaway*[60] that the CWA granted the Corps permitting jurisdiction over wetlands that were contiguous to navigable waterbodies. The United States Supreme Court in *United States v. Riverside Bayview Homes, Inc.*[61] confirmed that expansive interpretation in 1985. While the Supreme Court recently held in *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers*[62] that Corps jurisdiction does not extend to isolated wetlands, there is no question that the Corps has extensive jurisdiction to protect contiguous wetlands today.

IV. FLORIDA MOVES TO PROTECT WETLANDS

Florida first attempted to restrain--as versus foment--dredging and filling *of wetlands* in 1951.[63] The legislature repealed a 1917 Act that had rendered all tidelands between the upland and the channel subject to the control of the riparian upland owner.[64] This did little to restrain the state's conveyance or private dredging and filling of sovereignty lands.[65]

A. The Bulkhead Act

The 1957 Bulkhead Act took a palpable step toward ecological protection by authorizing the Trustees and local governments to set local bulkhead lines beyond which no private riparian landowner

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56. *Id.* at 214.
57. Pub. L. No. 92-500, 86 Stat. 816 (1972).
58. 33 U.S.C. § 1344 (1994).
59. The terms "navigable waters" and the undefined term "waters of the United States" expressed jurisdiction.
60. 392 F. Supp. 685 (D.D.C. 1975).
61. 474 U.S. 121 (1985).
62. 531 U.S. 159, 174 (2001).
63. MALONEY ET. AL., FLORIDA WATER LAW 459 (1980) (citing Act effective May 29, 1981, ch. 26776, 1951 Fla. Laws 554).
64. *Id.*
65. *Id.* at 459-60.

could fill.[66] The Act established permitting, as well as limitations on conveyances of submerged sovereignty lands, by the Trustees.[67] Under the Bulkhead Act, conveyances of such lands had to be in the public interest.[68] The Trustees agreed to give the counties power to create bulkhead lines within their jurisdictions subject to their approval.[69] In this way, local citizens and corporations would have a voice and the public interest would be better served.

As Dean Maloney stated, "the state was constrained in regulating dredge and fill activities prior to 1967."[70] Section 253.123(1), Florida Statutes, only allowed the Trustees to regulate submerged sovereignty lands; there was no regulatory authority in wetlands upland of the high water line.[71] The legislature created the Department of Pollution Control in 1967, and delegated to that agency the authority to regulate those previously unregulated wetlands.[72]

The State faces an interesting conundrum regarding those swamp and overflowed lands it acquired in 1850 under the Lands Act, and which it still owns. *Coastal Petroleum Co. v. American Cyanamid Co.* confirms that the State has established the primacy of sovereignty submerged lands title over swamp and overflowed lands claims.[73] Unlike sovereignty lands, though, there exists no presumption in favor of State ownership of swamp and overflowed lands. Nonetheless, the State retains swamp and overflowed lands generally to preserve them as natural resources.[74] This function has grown with the increased knowledge of how such lands function within the ecosystem and the State has actively pursued purchase or reacquisition of such lands through the Conservation and Recreational Lands program.[75] This is diametrically opposed to the original purpose of the Lands Act to facilitate filling and development of such lands. It is also inconsistent with the development goals of most private Spanish Land Grant titleholders. Therefore, the State seeks to assert and defend title in swamp and overflowed lands bare of the public trust presumptions it enjoys in its submerged sovereignty lands.

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66. *Id.* at 460.
67. *Id.*
68. *Id.*
69. *Id.*
70. *Id.* at 461-62.
71. *Id.* at 461 (citing FLA. STAT. § 253.123(1) (1979)).
72. *Id.*
73. 492 So. 2d 339 (Fla. 1986).
74. *See, e.g.*, FLA. STAT. § 259.101 (2001).
75. FLA. STAT. § 259.032 (2001).

Historical records of the United States Surveyors in Florida are fairly complete regarding field notes, plats, and contracts to individual surveyors. The instructions or special instructions to surveyors, however, are incomplete. Some are missing entirely from both State and national sources. Because of the condition of the documents and their incomplete nature, many Spanish surveys and records are sketchy at best. The records of the earlier Spanish surveys are often worse. Piecing together Spanish land grant titles often requires meticulous, tedious examination of surveys, instructions from the Crown, and more than a little luck. Much the same combination of art and science accompanies any attempt to ferret Lands Act titles. The remainder of this article traces the relationship between Spanish Land Grants and the Lands Act, and provides a primer on how one tries to piece together an historical title and boundary search to determine where Land Grant and swamp and overflowed lands exist.

V. BACKGROUND OF SPANISH LAND GRANTS

Spain ruled Florida through civil law.[76] The Florida Supreme Court discussed the Spanish colonial law as to waterfront lands at length in *Apalachicola Land & Development Co. v. McRae*:[77]

> When Spain acquired territory by discovery or conquest in North America, the possessions were vested in the crown; and grants or concessions of portions thereof were made according to the will of the monarch. While the civil law was the recognized jurisprudence of Spain and its rules were generally observed, yet the crown could exercise its own discretion with reference to its possessions.[78]
>
> Under the civil law in force in Spain and in its provinces, when not superseded or modified by ordinances affecting the provinces or by edict of the crown the public navigable waters and submerged and tide lands in the provinces were held in dominion by the crown . . . and sales and grants of such lands to individuals were contrary to the general laws and customs of the realm.[79]

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76. MALONEY, *supra* note 63, at 677-78.
77. 98 So. 505 (Fla. 1923).
78. *Id*. at 518.
79. *Id*.

> By the laws and usages of Spain the rights of a subject or of other private ownership in lands bounded on navigable waters derived from the crown extended only to high-water mark, unless otherwise specified by an express grant.[80]

This decision was recently re-examined and reconfirmed in the First District Court of Appeal in Florida in *Board of Trustees of the Internal Improvement Trust Fund v. Webb*.[81]

As the *McRae* court noted, Great Britain divided Florida into East and West Florida during British occupancy from 1763 to 1783.[82] The Chatahoochee and Apalachicola Rivers split East from West Florida.[83] Spain retained the East/West split when Florida reverted from Great Britain to Spain in 1783.[84] Florida became subject to United States law under the cession from Spain to the United States, effective in July, 1821.[85] The Treaty of Amity, Settlement and Limits Between the United States of America and His Catholic Majesty, the King of Spain ("Adams-Onis Treaty") established the terms of cession from Spain to the United States.[86]

The pertinent portion of the authoritative Works Projects Administration ("WPA") work, Spanish Land Grants in Florida (November 1940) ("Spanish Land Grants"), states the following regarding the effect of the Adams-Onis Treaty:

> By Article VIII of the treaty of February 22, 1819, whereby Spain ceded the Floridas to the United States, all Spanish grants of land made prior to January 24, 1818, the date on which the King of Spain definitely expressed his willingness to negotiate, were to be '*ratified and confirmed to the persons in possession of the lands, to the same extent that the said grants would be valid if the territories had remained under the domain of his Catholic Majesty*.'[87]

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80. *Id*.
81. 618 So. 2d 1381 (Fla. 1st DCA 1993).
82. 98 So. at 522-23.
83. *Id*.
84. *Id*. at 523.
85. *Id*.
86. *Id*. at 524 (citing the Treaty of Amity, Settlement and Limits Between the United States of America and His Catholic Majesty, the King of Spain, Feb. 22, 1819, U.S.-Spain, 8 Stat. 252 [hereinafter Adams-Onis Treaty]).
87. 1 THE HISTORICAL RECORDS SURVEY, DIV. OF CMTY. SERV. PROGRAMS, WORK PRODUCTS ADMINISTRATION, SPANISH LAND GRANTS IN FLORIDA xxxii (Nov. 1940) (emphasis added).

The WPA book explicates the methods for confirming title.[88] For example, a petitioner who sought confirmation of a Grant in what is today St. Johns County first obtained confirmation from the federal Board of Commissioners for East Florida if the Grant was under 3,500 acres in size, and, in turn and as appropriate, from Congress.[89] The principal federal records of United States confirmations of such Grants are in the "American State Papers," particularly, the pertinent American State Papers containing records of Congress relating to disposition of confirmation applications. Other important records include copies of the original documents of confirmation, which are available on microfiche, and the actual proceedings of the board of Commissioners for East (and West) Florida. The original documents often include copies of the original surveys.

The United States agreed to confirm title to valid Spanish Land Grants under the Adams-Onis Treaty. The transfer of Florida was specifically made subject to any pre-existing Spanish land grants:

> [A]ll the *grants of land* made before the 24th of January, 1818, by his Catholic majesty, or by his *lawful* authorities, in the said territories ceded by his majesty to the United States, shall be ratified and confirmed to the persons in possession of the lands, to the same extent that the same grants would be valid if the territories had remained under the dominion of his Catholic majesty.[90]

The Adams-Onis Treaty also granted an extension of time for grantees who had not yet fulfilled the terms of their grants to do so:

> But the *owners in possession of such lands*, who, by reason of the recent circumstances of the Spanish nation, and the revolutions in Europe, have been prevented from fulfilling all the conditions of their grants, shall complete them within the terms limited in the same, respectively, from the date of this treaty....[91]

Subsequent to the Adams-Onis Treaty, various acts of Congress were passed for settling private land claims in the ceded territories, pursuant to Article 8 of the Treaty, which provided that "all the

88. *Id.* at xxii, et seq.
89. *Id.* at xxii, et seq., and at 1, et seq.
90. *McRae*, 98 So. at 524 (citing the Adams-Onis Treaty).
91. *Id.*

grants of land made before the 24th of January, 1818, . . . in the said territories . . . shall be ratified and confirmed to the persons in possession of the lands, to the same extent that the same grants would be valid if the territories had remained under the dominion of" Spain.[92] While Spain ceded over East Florida and West Florida, Congress implemented Article 8 of the Treaty by ratifying and confirming Spanish Land Grants made prior to January 24, 1818, according to its terms.[93]

The United States Supreme Court in *United States v. Arredondo*[94] addressed at length the great legal weight afforded to Spanish Grants in Florida under the Adams-Onis Treaty and amendments to that Treaty:

> Yet, in [Congress'] whole legislation on the subject (which has all been examined), there has not been found a solitary law which directs; [sic] that the authority on which a grant has been made under the Spanish government should be filed by a claimant--recorded by a public officer, or submitted to any tribunal appointed to adjudicate its validity and the title it imparted--*[C]ongress has been content that the rights of the United States, should be surrendered and confirmed by patent to the claimant, under a grant purporting to have emanated under all the official forms and sanctions of the local government. This is deemed evidence of their having been issued by lawful, proper, and legitimate authority--when unimpeached by proof to the contrary*.[95]

The *Arredondo* court explained that the acts of the Spanish Colonial government and surveyor in issuing the grants and supporting surveys were "deemed" presumptively authorized "by the order and consent of the [Spanish] government."[96] But this was not always the case, and the U.S. Supreme Court at times had refused confirmation on numerous legal grounds, most often for lack of proper survey or vague boundary descriptions.

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92. *Id.*
93. *Id.* at 524-25; *see* State v. Gerbing, 47 So. 353, 355, 357 (Fla. 1908).
94. 31 U.S. (6 Pet.) 691 (1832).
95. *Id.* at 723 (emphasis added).
96. *Id.* at 727.

The Florida Supreme Court has held that Lands Act parcels could not contain lands that Spain had granted prior to cession:

> Under that treaty, the United States acquired the ownership of all the swamp and overflowed lands in the area now constituting the territorial limits of the state of Florida *that had not previously been granted by Spain* . . . .[97]

Dawson v. Mathews[98] addressed a dispute between claims under a Spanish land grant and swamp and overflowed lands. The case involved a suit to quiet title by Dawson, who claimed title to lands in Duval County through the McQueen Grant, a Spanish land grant,[99] against Mathews, who claimed through a Lands Act patent.[100] The McQueen Grant specified a waterfront eastern boundary.[101] Mathews claimed a portion of the McQueen Grant lands under a deed from Florida to certain "unsurveyed or marsh part of Section Twelve (12), Township Two (2) South, Range Twenty Eight (28) East . . . ."[102] The official United States survey of Section 12 showed Pablo Creek meandering across the Section 12 line, thereby creating a conflict between the boundary described in the McQueen Grant and the boundary designated by the United States survey.[103] The *Dawson* Court held as a matter of law that the purported boundary of Section 12 did not affect--let alone limit--the express eastern boundaries of the Spanish Land Grant.[104] The Spanish Land Grant was confirmed easterly pursuant to its terms, and the subsequently developed Government Survey system could not modify or abrogate those preexisting "[d]elineated boundaries of the Spanish Grant [that] speak for themselves."[105]

Conversely, the Florida Supreme Court in *Dumas v. Garnett* [106] determined that a purportedly waterfront Spanish Land Grant stopped short of the high water line. The plaintiff brought an action for ejectment to recover lands along the St. Augustine waterfront.[107] The plaintiff deraigned title through a Spanish Land Grant that was

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97. Trs. of Internal Improvement Fund v. Root, 58 So. 371, 376 (Fla. 1912) (emphasis added).
98. 338 So. 2d 1086 (Fla. 1st DCA 1976).
99. *Id.* at 1087.
100. *Id.*
101. *Id.*
102. *Id.*
103. *Id.*
104. *Id.*
105. *Id.*
106. 13 So. 464, 467 (Fla. 1893).
107. *Id.* at 466.

bounded on the eastern, waterward side by the "zacatel."[108] The testimony showed that a zacatel in Florida meant the location where marsh grass grows.[109] The court found that the evidence proved that the marsh was therefore the eastern boundary, and the plaintiff's grant went only to the western marshline.[110] Therefore, the Plaintiff could not eject a Defendant off of lands between the marshline and the waterfront.[111]

Dumas shows that it is crucial to know colonial historical and hydrogeological customs and standards when analyzing Spanish Land Grants. Sometimes, even exact knowledge of colonial practices does not suffice. If, for example, a marsh has been drained, how does the modern surveyor ascertain a colonial marshline boundary? The surveying standards in colonial Florida and today might dictate reliance on any distances shown in the metes and bounds in the original Spanish survey. Typically, however, "monuments" such as a river or marshline would control over a distance in a survey.[112] One may seek to establish approximate colonial boundaries by the distance, however, where filling or other alterations eliminated or altered the historic marshline.

Also, U.S. Deputy Surveyors "retraced" the survey lines of the Spanish surveyors to the best of their abilities. There is ample evidence, however, to conclude that many surveys in East Florida, specifically those more than fifteen miles outside of St. Augustine or Fernandina, were never performed upon the ground.[113] This meant that the U.S. Deputy Surveyor had to simply reconstruct the survey *in toto* from a plat or verbal description.[114] Frequently, such descriptions differed dramatically from the actual geographic features of the land.[115] Numerous letters in the series, "Letters and Reports to Surveyor General," often reflect this frontier reality.[116] Surveyors also were required to comply and almost always complied with the rule that local newspapers include advertisements for the land owners or their representatives to show up at a certain place and time

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108. *Id.*

109. *Id.* at 465. The testimony regarding the definition of "zacatel" demonstrated the significance of knowledge of colonial Florida, as opposed to other Spanish colonies. A witness for the Plaintiff testified that "zacatel" in Mexico meant the place where the grass grows and indicated a prairie. That witness was unaware of the definition in colonial Florida. *Id.*

110. *Id.* at 466-67.

111. *Id.* at 467.

112. *See generally* Trs. of the Internal Improvement Trust Fund v. Madeira Beach Nominee, Inc., 272 So. 2d 209 (Fla. 2d DCA 1973).

113. *See* Joe Knetsch, *The Spanish Land Grants of Central Florida: Another Problem for Surveyors*, FLA. SURVEYOR, May-July 1997, at 18, 22.

114. *Id.*

115. *Id.*

116. *See id.* at 19, 21-22.

to locate and fix the boundaries for their grants.[117] Three weeks was the usual time for the running of these advertisements. U.S. Deputy Surveyors took deliberate pain and caution to relocate the land grants to the grantees' satisfaction. In cases where the boundaries were recently run by Spanish surveyors, the lines were often still quite visible on the ground

A grant's size in acres is also another method used to determine the grant's approximate shape in cases where physical monuments have been destroyed or greatly altered. This, however, is the least favored method used by surveyors in determining grant boundaries.

Spanish settlements were highly regulated affairs. Swamps, marshes, and other lands of perceived marginal use were often designated as "common" lands for all settlers to use to their benefit. Nonetheless, some marshes were used for forage and other agriculture, as well as access to riverine "highways." Swamps were to be typically avoided as places for the erecting of towns. All towns had to conform to the typical Spanish square pattern, with the direction of the prevailing winds of especial note. Land Grants along rivers, navigable streams, and roadways were typically (although not always) required to be two-thirds in depth and one third in frontage, thereby giving equal access to all land owners to these royal highways of commerce and transportation. Rules regarding the layout of the church, royal offices, streets, and other such affairs were also strictly defined in Spanish law. Only lands of practical use, generally farming, were to be granted to individuals. Spain, like England and France of the day, operated under the mercantile system developed by Colbert. This system dictated that colonies existed for the good of the mother country, and only things not produced there could be raised and exported to the homeland. Therefore, colonial development and settlement patterns were highly regulated and controlled.

VI. FLORIDA RECEIVED QUITCLAIM DEEDS UNDER THE LANDS ACT

Florida courts in *Root* and *Dawson* ruled that the United States could not have acquired from Spain title to lands Spain had already transferred into private hands.[118] In turn, the United States could not have conveyed good title to such lands to Florida by operation of the Lands Act. The Trustees took title under Lands Act patents from the United States pursuant to 43 U.S.C. ' 982. The Lands Act had the following purpose:

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117. *Id*. at 19.

118. Trs. of Internal Improvement Fund v. Root, 58 So. 371, 376 (Fla. 1912); Dawson v. Mathews, 338 So. 2d 1086, 1087 (Fla. 1st DCA 1976).

> §982. Grant to States to aid in construction of levees and drains
>
> To enable the several States . . . to construct the necessary levees and drains, to reclaim the swamp and overflowed lands therein B the whole of the swamp and overflowed lands, made unfit thereby for cultivation, *and remaining unsold on or after the 28th day of September, A.D. 1850*, are granted and belong to the several States respectively, in which said lands are situated . . . .[119]

The federal case law shows as a matter of law such patents could not affect *previously confirmed* Spanish Grants. It is instructive to consider dicta in a federal Fifth Court of Appeals case concerning lands within what is now St. Augustine, St. Johns County Airport. In *Mays v. Kirk*,[120] the old Fifth Circuit, on jurisdictional grounds, reversed and remanded to the United States Middle District of Florida Mr. and Mrs. Mays's judgment removing a federal Swamp Lands patent to Florida as a cloud on their alleged Spanish Grant title. While the Court held that there was no federal court jurisdiction, it noted:

> [I]t remains open to [the Mays] to show that the land never belonged to the United States, i.e., *that it belonged to private owners in the period since [the alleged Spanish Grant root of title], and that therefore the United States could not by the Swamp Lands Act convey something it did not own*. See United States v. O'Donnell where the Court stated:
>
> 'By its terms the Swamp Lands Act did not include swamp lands which the Government had sold, *and it could not include lands which the Government had not acquired or free any of them of obligations to which they were subject when the Act was passed*.'[121]

119. 43 U.S.C. § 982 (emphasis added).
120. 414 F.2d 131, 136 (5th Cir. 1969).
121. *Id.* (citations omitted) (emphasis added).

In *United States v. O'Donnell*, the United States Supreme Court held that swamp lands in California were subject to a treaty between the United States and Mexico, which addressed preexisting Mexican titles.[122] Congress passed the Mexican Land Claims Act to confirm title to lands conveyed by Mexico prior to the United States' acquisition of the swamp lands.[123] Just like the Adams-Onis Treaty's effect on Spanish Land Grants in Florida, "[t]he primary purpose of the Mexican Claims Act was the performance by the United States of its treaty obligations to quiet the titles of the claimants under Spanish and Mexican grants."[124] The Supreme Court in *O'Donnell* stated that confirmed Spanish and Mexican Grants rendered void Swamp Lands Act patents of the same lands:

> *It is evident that the treaty obligations to quiet the title of claimants under Mexican grants would be defeated and the Mexican Claims Act would fail of its purpose if the finality of the [federal] confirmation of claims under Mexican grants could be challenged by persons claiming under grants of public lands by the United States.* For that reason it has been consistently held that . . . confirmation under that act of claims under Mexican grants is conclusive upon all those claiming under the United States. Such is the effect of confirmation . . . of titles set up under Mexican grants, upon claimants under the Swamp Lands Act to lands in the annexed territory.[125]

The *O'Donnell* Court explained that Swamp Lands Patents were quitclaim deeds subject to superior and preexisting claims:

> The Swamp Lands Act of 1850 was effective to transfer an interest in the lands described in the Act, *only so far as they were part of the public domain of the United States and thus subject to the disposal of Congress.* The Act in terms purported to grant to the several states all swamp and overflowed lands located within their respective boundaries "which shall remain unsold at the passage of this Act." [Section 1, 46 [now 43] U.S.C.A. ' 982] . . . By its terms the Swamp Lands Act did not include swamp lands which the Government

122. 303 U.S. 501, 510 (1938).
123. *Id.* at 512-13.
124. *Id.* at 512.
125. *Id.* at 512-13 (citations omitted)(emphasis added).

> had sold, *and it could not include lands which the Government had not acquired or free any of them of obligations to which they were subject when the Act was passed*.[126]

VII. RIPARIAN VERSUS WETLANDS BOUNDARIES

In *Borax Consolidated v. City of Los Angeles*, the court held that the mean high water line demarcates the boundary between private uplands and submerged sovereign lands underlying tidally influenced navigable waters.[127] The *Borax* court also noted that the United States did *not* take title to lands, subject to reconveyance, where title to those lands had previously been granted by Mexico.[128]

Various Florida cases have held that Spanish land grants along navigable water bodies were bounded by the mean or ordinary high water line as applicable, unless the grants otherwise stated. For example, the Florida Supreme Court stated in *Apalachicola Land & Development Co. v. McRae*, "[b]y the laws and usages of Spain the rights of a subject or of other private ownership in lands bounded on navigable waters derived from the crown extended only to high-water mark, unless otherwise specified by an express grant."[129]

Many Spanish land grants state the lands are bounded by a "bank." Typically, a bank is deemed to be the high water line. The United States Supreme Court in *Barney v. Keokuk*[130] held that the bank of a navigable waterbody is synonymous with the ordinary (or mean in tidally influenced waters) high water line boundary. Additionally, the Florida First District Court of Appeal in *Teat v. City of Apalachicola*,[131] stated:

> Appellants live along the banks of Huckleberry Creek, a tidal and navigable waterway, and their deed conveys land that runs to the bank of this creek.

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126. *Id.* at 509-10 (emphasis added). The portion of the *O'Donnell* opinion cited in *Mays* is instructive. *See also O'Donnell*, 303 U.S. at 514-15 ("Even where the right of the state under the Swamp Lands Act is unqualified, it would perhaps be more accurate to say that the United States is no more than a donor granting without warranty those lands falling within the description and the purview of the statute . . . ").

127. 296 U.S. 10 (1935).

128. *Id.* at 15.

129. 98 So. 505, 518 (Fla. 1923).

130. 94 U.S. 324, 336 (1876).

131. 738 So. 2d 413, 413 (Fla. 1st DCA 1999).

> *We hold that . . . property that extends to the shore extends to the ordinary (sic) high water mark, and riparian rights are attached to that property. Under the facts of this case, the banks of Huckleberry Creek are the equivalent of a shore.* Therefore, appellants do possess riparian rights.[132]

Teat and *Barney* together show that one who owns lands adjacent to the "bank" of a navigable waterbody owns down to the mean or ordinary high water line, as appropriate. (Since *Teat* addressed the boundary of a "tidal and navigable waterway," the bank ran along the *mean*, not the ordinary, high water line.)

The Florida Supreme Court in *State v. Black River Phosphate Co.*,[133] also held that a "bank" serves as the physical boundary between private uplands and navigable waters. Similarly, the Florida Supreme Court in *Brickell v. Trammell*,[134] held that federal confirmation of a Spanish Land Grant "on the south side of Miami river" extended to the mean high water line under both Spanish and common law. Compare *McRae*, which states the "shores" of a navigable water are "the spaces between high and low water marks," and *Teat*, which treated the "banks" as the "equivalent" of a "shore" along the mean high water line.[135]

VIII. CONCLUSION

The determination of boundaries of Swamp and Overflowed lands is generally difficult. The determination of boundaries of Spanish Land Grants, is likewise difficult. The correct result--or even a defensible one--requires a unique knowledge of Spanish Colonial Law, surveying, history, law and more than a little luck. The authors of this article have had good faith disputes based on defensible and wildly divergent interpretations of the same historical documents. While we hope that we have provided a useful template, we council caution. In analyzing these issues, try to follow that hoary old lesson of trial lawyers: Try to determine how the other side might interpret the same records. A final word of caution: If all else fails, and you are still confused, flip a coin.

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132. *Id.* at 414 (emphasis added). The court's citation to the "ordinary high water mark" was an error. Because the court found that the creek was tidal, the mean, rather than ordinary high water line applied.

133. 13 So. 640, 650 (Fla. 1893).

134. 82 So. 221, 229 (Fla. 1919).

135. Apalachicola Land & Dev. Co. v. McRae, 98 So. 505, 525 (Fla 1923); *Teat*, 738 So. 2d at 414.

Proceedings of the 8th Annual Public Interest Environmental Conference:

"Industry is from Mars, Environmentalists are from Venus: Reconciling Our Differences on Earth."[1]

The Conference was held February 14–16, 2002 at the Reitz Union, University of Florida. More than 180 Conference participants, including students, professors, attorneys, advocates and environmentalists from across Florida, joined 70 panelists representing industry, environmental groups, academia and government agencies, to attend the conference. These Proceedings include articles from Conference speakers addressing the issues discussed at the Conference.

The Conference was designed to address several of Florida's major industries: Agriculture, Development, Infrastructure and Tourism. The Conference was organized into tracks to allow Conference participants to follow a particular industry track for the day, or to sample a variety. Why the focus on industry? We felt it was valuable to create a forum to examine whether industries are adopting sustainable alternatives to traditional practices, and where they are headed in the future. More importantly, we wanted to examine how attorneys can help influence sustainable development in these industries through a variety of methods.

This emerging corporate paradigm shift is based on more than pure altruism. The Dow Jones Sustainability Indexes, specialty indexes compiled by Dow Jones based on social, environmental and long term economic dimensions, perform consistently with the Dow Jones Index, proving that socially responsible investing is economically viable. Opponents of corporate sustainability assert

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1. The authors of these proceedings accept responsibility for the accuracy of their information, quotations, and citations.

that the movement is "green washing" and has no substantive value. We encouraged conference participants to engage in a healthy and respectful debate about these issues.

Our Reception Keynote Speaker, Dr. David Guggenheim, Vice-President for Conservation Policy at the Ocean Conservancy, addressed the ocean wilderness concept followed by a discussion at the Friday plenary regarding the impact of ocean wilderness on tourism. Dr. Charles J. Kibert (*Policy Instruments for a Sustainable Built Environment*) and Professor Ruhl (*Three Questions for Agriculture about the Environment*), also speakers at the Friday plenary, introduced the remaining industry tracks. Our Banquet Keynote Speaker, Gary Guzy, (*Reconciling Environmentalist and Industry Differences: The New Corporate Citizenship "Race to the Top"?*), a partner with Foley, Hoag & Eliot, LLP in their Corporate Social Responsibility practice group, addressed the history of environmental law and discussed how some corporations are increasingly including environmental and social considerations into their operating plans well in advance of government regulation, particularly in areas related to climate change. The Saturday plenary, *Energy Solutions: Encouraging Sustainability* included speakers from both regulator and regulatee standpoints including Deb Swim (*Creating a Sustainable Energy Future for the Sunshine State*), Greg Nelson for Richard Lehfeldt (*Industry is from Mars, Environmentalists are from Venus: Reconciling Our Differences on Earth – A Utility Perspective*), Lt. Col. Louis J. Puleo (Conservation Issues on Military Lands: Some Thoughts on a Framework for Successful Mission Integration), and the *Panel: Ethical Dilemmas: Finding Common Ground on Controversial Issues*, featuring Lesley Blackner, Richard C. Foltz, Anna L. Peterson and moderator Brion Blackwelder.

For additional information on these issues, please visit the following Corporate Sustainability and Accountability Websites:

1. Business Charter for Sustainable Development *at* http://www.iccwbo.org/home/environment/charter.asp
2. Business in the Environment *at* http://www.business-in-environment.org.uk/
3. Business for Social Responsibility (BSR) *at* http://www.bsr.org/
4. CERES *at* http://www.ceres.org/
5. CorpWatch – Holding corporations accountable *at* http://www.corpwatch.org/
6. Dow Jones Sustainability Group Indexes (DJSGI) *at* http://www.sustainability-index.com/
7. Friends of the Earth – Corporate Accountability *at* http://www.foe.org/international/corp_acc/

8. Global Environmental Management Initiative (GEMI) *at* http://www.gemi.org/
9. Global Exchange – Democratizing the Global Economy *at* http://www.globalexchange.org/economy/
10. Global Reporting Initiative (GRI) *at* http://www.globalreporting.org/
11. Innovest Strategic Value Advisors *at* http://www.innovestgroup.com/
12. Stakeholder Alliance *at* http://www.stakeholderalliance.org/index.html
13. World Business Council on Sustainable Development *at* http://www.wbcsd.ch/

We invite you to attend the 9th Annual Public Interest Environmental Conference, February 27th – March 1st, 2003. Please see our website for details *at* http://grove.ufl.edu/~els.

Regina Fegan Nicole C. Kibert

Conference Co-Chairs,
8th Annual Public Interest Environmental Conference

POLICY INSTRUMENTS FOR A SUSTAINABLE BUILT ENVIRONMENT

CHARLES J. KIBERT*

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I. INTRODUCTION

I have been asked to address policy issues that can move the industries that create, operate, and dispose of the built environment to a condition approximating sustainability. Many of the generally acknowledged global environmental problems (greenhouse warming, ozone depletion, soil erosion, acid rain and eutrophication, to name a few) are directly or indirectly caused by the creation, operation, or disposal of the built environment. For instance, 30% of all primary energy in the U.S. is consumed by the built environment, with approximately 40% in many of the Organization for Economic Cooperation and Development (OECD) countries. Consequently, much of the impact of energy (coal, oil, natural gas, and uranium) extraction and processing, power plant construction and operation, associated transmission lines, and transportation (trucks, trains, barges and ships) can be attributed to building operation. Much of the impact of automobile manufacture, operation, and disposal is tied to the distribution of the built environment on the landscape. Therefore, the impacts of buildings extend far beyond the physical boundaries of the

* Director and Professor, M.E. Rinker Sr. School of Building Construction, University of Florida, Gainesville, Florida.

structures and infrastructure themselves. Similarly, 40% of all materials extracted in the U.S. end up in buildings or infrastructure.

For policy instruments to be effective, they must comprehensively and holistically address the wide range of activities directly or indirectly connected to the built environment. Clearly this is an enormous undertaking and an appropriate scope must be selected to address these problems in a reasonable manner. The main categories of policy instruments applicable to the built environment will be explored here for their use in improving the performance of the various stages of built environment activity: the supply chain, building creation and disposal, and building operations.

II. RESOURCE AND ENVIRONMENTAL IMPACTS OF THE BUILT ENVIRONMENT

The construction industry dominates worldwide materials consumption. About 40% of all materials extracted annually in the U.S. end up in the built environment.[1] Construction activity amounts to about 8% of the U.S. GDP, meaning that the material impacts of construction far outweigh its relative size in the economy. At present, over 2.1 billion metric tons (BMT) of materials are incorporated into buildings and built environment infrastructure each year. In 1999, cement consumption in the U.S. was 105 million metric tons (MMT). The lifetime of buildings is relatively long compared to other artifacts, resulting in the accumulation of vast quantities of materials (Figure 1). It has been estimated that over 90% of all the materials ever extracted in the U.S. are in today's built environment.[2] Consequently, policy must address this enormous, burgeoning stock of materials to ensure that it becomes, to the greatest degree possible, a resource for future generations rather than an enormous waste disposal problem.

1. I.K. Wernick & J.H. Ausubel, *National Materials Flows and the Environment*, 20 ANN. REV. ENERGY & ENV'T 463-92 (2000).

2. C. Kibert et al., *Defining and Ecology of Construction, in* CONSTRUCTION ECOLOGY: NATURE AS THE BASIS FOR GREEN BUILDINGS (C. Kibert et al. eds. 2002).

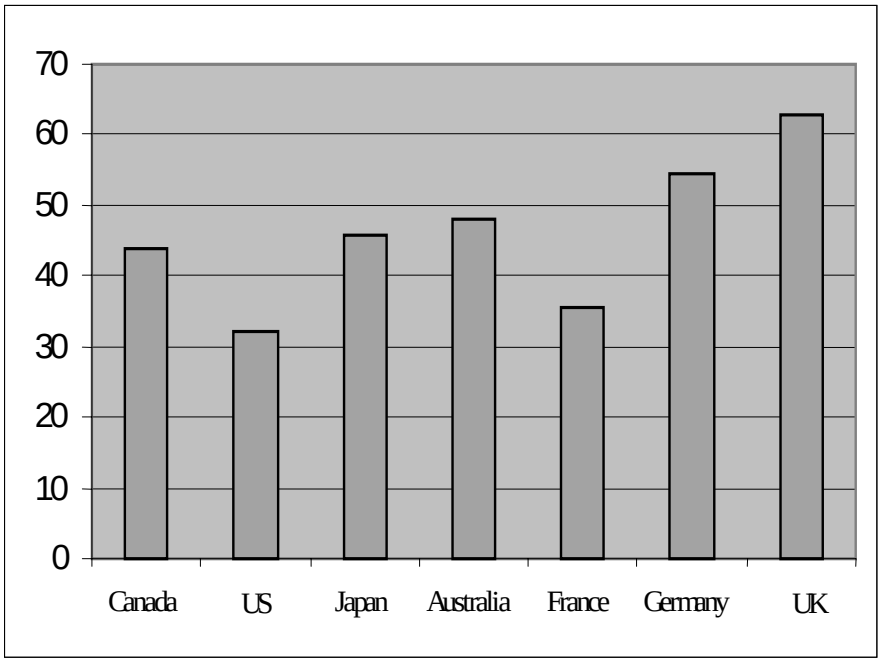

Figure 1. Estimated average service life of buildings in selected countries[3]

Waste from construction activities is enormous. Presently, the U.S. annually creates over 145 MMT of construction and demolition waste. This compares to a municipal solid waste (MSW) stream of about 280 MMT, meaning that construction and demolition waste comprises about one-third of the total materials being landfilled. Of the total construction and demolition waste stream, about 92% is attributed to demolition activities and 8% is waste from construction activities--either new buildings or renovation of existing structures. Waste from new construction amounts to 27 Kg/m2, while the quality of waste from renovation activities in typical commercial buildings can be as much as 320 Kg/m2.

Of possibly greater consequence is the Ecological Rucksack of construction, or the total quantity of material that must be extracted to obtain a unit of pure material. For example, for iron ore extraction, the Ecological Rucksack can be expressed as the ratio 14:1, that is, 14 metric tons of waste in the form of tailings or mine

3. T. Hasegawa, *Policy Instruments for Environmentally Sustainable Buildings, Organization for Economic Cooperation and Development*, ENV/EPOC/WPNEP 6 (2001).

waste is the result of producing 1 metric ton of iron. For rarer materials, such as gold and platinum, the ratio can range up to 350,000:1. For the most massive quantities of materials used in the built environment--sand, gravel, and stone--the Rucksack is not so unfortunate, with a ratio of 1:0.86 for gravel and 1:1.2 for natural stone. Coal extraction's ratio is 1:5 while that for petroleum is 1:0.1. In addition to the Ecological Rucksacks, the relative scales of extraction need to be considered. For the materials mentioned here, 10 BMT of sand and gravel, 5 BMT of stone, 5 BMT of coal, 5 BMT of petroleum, 0.5 BMT of iron, and 0.0001 BMT of gold were extracted worldwide in 1994 (see Table 1).[4]

Material	Ecological Rucksack	Scale (BMT)
Oil	1:0.1	5
Sand/Gravel	1:0.86	10
Natural Stone	1:1.2	5
Coal	1:5	5
Gold	1:350 000	0.0001

Table 1. Ecological Rucksack and scale of selected materials.

Buildings as artifacts of human society are also distinguished to a large extent by their relatively large land requirements, and the environmental effects of the cooption of this valuable ecological resource. The built environment significantly modifies natural hydrologic cycles, contributes enormously to global environmental change, has tremendous effects on biodiversity, contributes to soil erosion, has major negative effects on water and air quality, and, as noted above, is the source of major quantities of solid waste. In the U.S., as noted earlier, construction and demolition waste is the major source of industrial waste, amounting to perhaps 500 Kg per capita, or on the order of 145 MMT annually. The reuse and recycling rates of this waste is not well known, but is probably under 20% of the total mass and probably closer to 10%. Only concrete recycled for its aggregates and metals are recycled at high rates because of their relatively high economic value.

4. E. VON WEISZKER ET AL., FACTOR 4: DOUBLING WEALTH, HALVING RESOURCES USE (1997).

III. STATUS OF GREEN BUILDING

Describing the current state of movements to green the built environment would be useful in establishing a context for understanding the need to develop a sound basis for policy development. There are many terms used to describe these movements. In addition to green building, terms such as sustainable construction, sustainable architecture, ecological architecture, ecologically sustainable design, and ecologically sustainable development have been used. The term *sustainable construction* seems to be the most comprehensive description of all the activities involved in trying to better integrate the built environment with its natural counterpart. Begun as an international movement in 1993, sustainable construction can be defined as "creating a healthy built environment based on ecologically sound principles." It looks at the entire life cycle of the built environment: planning, design, construction, operation, renovation and retrofit, and the end-of-life fate of its materials. Sustainable construction considers the resources of construction to be materials, land, energy, and water and has an established a set of principles to guide this new direction (See Table 2).[5]

Table 2. Principles of Sustainable Construction

1. Reduce resource consumption
2. Reuse resources to the maximum extent possible
3. Recycle built environment end-of-life resources and use recyclable resources
4. Protect natural systems and their function in all activities
5. Eliminate toxic materials and by-products in all phases of the built environment

Many of the organizations involved in the greening of the built environment have set out similar principles, all of them having much in common with the principles of sustainable construction. Progress in implementing these principles has been impressive. A comprehensive overview of programs in countries around the world would be lengthy and, for the sake of brevity, a review of the United States' progress will be used as indicative of how rapidly change is taking place worldwide. In the U.S., there are several major entities driving the emergence of green buildings: the U.S. Green

5. C. Kibert, *Establishing Principles and a Model for Sustainable Construction*, 1994 PROC. FIRST INT'L CONF. ON SUSTAINABLE CONSTRUCTION 3-12.

Building Council, the National Association of Home Builders, and the federal and local governments.

A. The U.S. Green Building Council

The U.S. Green Building Council (USGBC), established in 1993, represents a wide range of actors- architects, engineers, product manufacturers, academics, and public institutions- who concluded that the construction industry must change course to be sustainable. In the U.S., the construction industry clearly has disproportionate impacts on the environment compared to other sectors of the economy. At present, although it represents just 8% of the U.S. Gross Domestic Product, the construction industry is responsible for over 40% of total materials extracted to produce and alter buildings and infrastructure, and the operation of buildings consumes over 30% of the nation's primary energy. In a fashion similar to its counterparts in other major industrial countries, as its response to changing the playing field, the USGBC organized a system of rating buildings that would add new criteria for the siting, design, construction, and operation of new and renovated buildings in the U.S. This rating system, known more commonly by its acronym of LEED (Leadership in Energy and Environmental Design), proposed to classify buildings into four categories, depending on their level of performance with respect to energy and environmental issues: platinum (highest), gold, silver, and LEED-rated. In the short time since its proposal and subsequent piloting, the LEED Standard must be declared a major success. Scores of buildings have been designed and built using its criteria and many more are queuing up to employ it as perhaps the key focus for building design, ranking only behind the client's requirements for the building's function. The LEED Standard is being expanded into other sectors of building construction to include residential housing. Starting in 1998, the beta testing of the Standard was conducted, and over 30 buildings received ratings based on Version 1.0. In April 2000, the final Standard, Version 2.0 was issued and is now being used to rate commercial and institutional buildings.[6]

6. See the U.S. Green Building Council website for information on the LEED standard *at* http://www.usgbc.org.

B. The National Association of Home Builders

The National Association of Home Builders (NAHB) is generally considered to be the most powerful construction industry organization in the U.S., with over 200,000 members organized into 800 local chapters. The NAHB stated there were over 1.6 million single and multi-family housing starts in 1999. In 1998, the private sector produced over 214 billion dollars of family housing, constituting about one-third of the value of total construction in the U.S. Home ownership is a significant aspect of American culture. Ownership of a home is highly valued and homes represent a significant portion of wealth. Approximately 44% of the nation's total net worth was represented by the homes ownership in 1993.[7] The high level of home building also represents a significant proportion of the environmental impacts of construction, especially in terms of its land consumption. Fortunately, several homebuilder associations have actively engaged in determining how to build homes in an environmentally friendly manner. At least six of these associations, often in cooperation with local jurisdictions, have established a variety of green builder programs. In addition, the NAHB now has an annual national conference devoted to green home building.

C. Federal and Local Government

Of all the organizations involved in green building efforts in the U.S., the federal government is both the largest customer and arguably its greatest proponent. A wide array of federal agencies have demanded better environmental and health performance for new buildings, such as the U.S. Post Office, the National Park Service, and many of the military services. Many of the buildings that were rated by the first version of the LEED Standard in the beta testing effort were federal buildings. The U.S. Department of Energy has been a major supporter of the development and implementation of the LEED Standard. Presidential Executive Orders have directed a variety of actions on the part of federal agencies that directly or indirectly supported the construction of green buildings. Several highly visible federal building efforts such as the "Greening to the White House" and the "Greening of the Pentagon" have been effective in publicizing green buildings in the U.S.

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7. See the National Association of Home Builders website for statistical data on home ownership and construction *at* http://www.nahb.org.

Local government has also been a major force in the green building movement in the U.S. The municipal government of Austin, Texas initiated a green building program in the early 1990s. The Austin effort was initially directed at the procurement of city buildings and produced the first guidelines for municipal building--the Sustainable Building Sourcebook. The city's efforts soon produced a parallel effort in the local homebuilding industry, and the Austin homebuilders association formed the first NAHB green residential construction program. The city of Seattle, Washington now requires conformance to the LEED Standard for all municipal buildings and similar requirements for the use of the LEED Standard are emerging from local government across the U.S. The city of Boulder, Colorado was the first municipality to require some level of green building measures for all housing constructed within city limits and enforces this requirement through the building permitting process.

IV. CATEGORIES OF POLICY INSTRUMENTS

A wide array of policy instruments is available to assist citizens and government in altering the present unsustainable course of human behavior. Table 3 contains a general list of these instruments.

Regulatory Instruments

- Technology-based standards: mandatory standards which describe an approved technology for a particular industrial process or environmental problem and greatly emphasize the design and use of preventive methods.
- Performance-based standards: mandatory standards which define a firm's duty in terms of the problems it must solve or the goals it must achieve, focusing on the outcome and avoiding overt prescription.

Economic Instruments

- Emission charges and taxes: direct payments based on the quantity and quality of a pollutant.
- Product charges and taxes: payments applied to products that create pollution when manufactured, consumed or disposed (e.g. fertilizers, pesticides, or batteries).
- User charges: payments for the cost of collective services. They are primarily used for the financing of local authorities, e.g. for the collection and treatment of solid waste and sewage water. In the case of natural resource management, user fees are payments for the use of a natural resource (e.g. park, fishing, or hunting facility).
- Marketable (tradable, transferable) permits: these consist of environmental quotas, permits, maximum rights allocated to economic agents by a competent authority. Once the initial allocation is made, these permits can be transferred (traded) between sources, geographical areas or time periods (see Section II).
- Deposit-refund systems: payments made when purchasing a product (e.g. packaging). The payment (deposit) is fully or partially reimbursed when the product is returned to the dealer or a specialized treatment facility. I).
- Non-compliance fees: payments imposed under civil law on polluters who do not comply with environmental or natural resource management requirements and regulations. They can be proportional to selected variables such as damage due to non-compliance, profits linked to reduced (non-) compliance costs, etc.
- Performance bonds: payment of a deposit (in the form of a "bond") imposed on polluters of users of natural resources. The bond is refunded when compliance is achieved.
- Liability payments made under civil law to compensate for the damage caused by a polluting activity. Such payments can be made to "victims" (e.g. in cases of chronic or accidental pollution) or to the government; can operate in the context of specific liability rules and

compensation schemes, or of compensation funds financed by contributions from potential polluters (e.g. funds for oil spills). ● Environmental subsidies: all forms of explicit financial assistance to polluters or users of natural resources, e.g. grants, soft loans, tax breaks, accelerated depreciation, etc. for environmental protection. In general, environmental subsidies are in contradiction with the Polluter-pays principle, except in exceptional circumstances, as defined by the OECD Recommendation (OECD 1972).
Information tools ● Public information campaign: a campaign that aims to raise public awareness of environmental issues. ● Technological information diffusion programs: provision of technological information for producers with the aim to change the behavior of firms to be more environmentally friendly. (e.g. information services, demonstration program) ● Environmental labeling schemes: provision of information on the environment-related performance of products which is certified by third parties or the producers themselves according to predetermined criteria.
Voluntary policy tools ● Unilateral commitment or declaration: a program created unilaterally by an enterprise and/or a business without any public organization being involved. ● Negotiated agreement or commitment: a program involving a contractual arrangement between a public organization and an enterprise or business group. ● Selective regulation or public voluntary program: a program in which governments provide the framework for the policy, but leave participation up to the judgment of enterprises.
Research and development tools ● Support for the research and development in the private sector, direct commitment to the R&D activities or establishment of a partnership with the private sector.

Table 3. Categories of policy instruments for use in achieving sustainability objectives[8]

8. *See* Hasegawa, *supra* note 3.

V. CASE STUDY

Perhaps the industry most nearly approaching the ideals of a true ecology of construction in the U.S. is the carpet tile industry. Carpet tiles are semi-rigid squares (typically 450 mm per side) of carpet that are used in commercial and industrial applications. The advantage of this carpeting system is that areas of carpet that become worn out due to heavy traffic or damage can be simply removed and replaced with new carpet tiles. For a variety of reasons, several major manufacturers of carpet tiles are competing for market share based, at least partially, on the recyclability of their products. Among these manufacturers are Interface, Collins & Aikman, and Milliken. Each of these manufacturers has evolved a different strategy for competing in this age of emerging awareness of greening issues.

Interface recently released information about a new product called Solenium, a hybrid carpet-resilient flooring material. Although it is a composite of several different layers of materials (PTT face fiber, fiberglass and carbite adhesive, polyurethane cushion, and polypropylene secondary backing), it is designed for disassembly. At about 190oC, the adhesive bonding between the face fiber and urethane cushion dissociates, allowing the materials to be peeled apart for recycling. The secondary backing can be manually peeled away from the urethane cushion (EBN 1999a). Although the new product does require some virgin materials for its manufacture, the bulk of the materials can be recycled into new product. Interface also offers materials such as Solenium as "Products of Service," meaning that they can be leased from Interface who then takes on the responsibility for maintaining, removing worn sections, and recycling the used materials into new products.

Backing materials are one of the most important components of carpeting because they come in contact with the underlying surface and must have adequate toughness, strength, and durability to withstand the wide variety of loads to which they will be subjected. Collins & Aikman created a new backing material which they refer to as Powerbond ER3 and which contains up to 50% post-consumer waste in the form of old carpet from its competitors. The remainder of the ER3 product is internal production waste and post-industrial automotive waste. The manufacturer claims that the ER3 backing may in fact be superior to backing it manufactures made of 100% virgin materials.

Milliken's approach to effective materials use is to remanufacture used carpeting by deep cleaning, retexturing the surface and overprinting a new pattern on top of the old color. As

part of their marketing strategy, Milliken is planning on selling a product called "Precycle" which indicates the carpet tiles are designed for remanufacture and with an eye to potential color schemes for future generations of remanufactured product. Remanufactured carpeting also carries a significant financial incentive, because the cost of the remanufactured version is half that of the new carpet tiles.

Raw materials manufacturers such as Dupont, AlliedSignal, BASF, and DSM Chemicals are also participating in related closed loop materials ventures. In a new venture called Evergreen Nylon Recycling, AlliedSignal and DSM are building a facility that recycles a variety of nylon called *nylon 6*, which is highly recyclable. In effect the recycled polymer is identical to the virgin polymer and thus 100% recyclable. A process known as *selective pyrolysis* uses heat and steam to separate the constituent products of the nylon carpet, and *caprolactam*--the building block of *nylon 6*--rises to the top of the vat during processing. To assist with identifying carpet containing *nylon 6* and to prevent contamination from other types of nylon carpeting, AlliedSignal developed a hand-held infrared device to assist contractors in the collection of the appropriate used carpeting in the field.

These actions and strategic moves by carpet tile manufacturers and raw materials producers for the carpet industry are perhaps the most comprehensive example of the evolution of a construction ecology that has similarities to its natural ecology. For the first time, manufacturers are actually competing not only on the function and cost of their products, but also on the ability of the materials to be kept in a closed loop system of manufacture-use-recovery-manufacture. The question that emerges from observing this one segment of construction materials is: when can we expect to see similar progress in other product segments, such as wall panels or acoustical tiles? The carpet tile industry is providing ample evidence that systems approaching the ideals of a construction ecology with behavior similar to a natural system are both achievable and profitable.

The flooring industry is an anomaly in that the industry has moved towards waste minimization of its own volition without regulatory incentive. However, in other industries, the voluntary adoption of life cycle analysis is unlikely to occur without some regulation and incentives. Therefore, in order to use the lessons learned from the carpet and flooring industry regarding the possible innovation in life cycle approaches to products that result in waste minimization, a framework has been designed using the OECD classification of policy instruments shown in Table 3, focusing on the Regulatory, Economic, and Informational instruments (See

Table 4). Note that in Table 4 the label "consumer" refers to the actor that procures the product from the producer. In the case of carpet tiles, the consumer would be the carpet subcontractor who purchases and installs the tiles. The following paragraphs address the various policy instrument possibilities by phase of the built environment.

A. Design and Construction

Regulations could require producers to take life cycle responsibility for their products, thus designing them for recycling, using Design for the Environment principles. Another regulatory option would be to require producers to use recyclable materials in their products. This could include a scheme similar to Extended Producer Responsibility (EPR), in which the producer is required to take back both used and waste products they had manufactured. For the consumer or builder, a requirement that buildings contain a certain minimum percentage of recycled content and recyclable materials would be in order. Producers could also be required to use specific materials for specific products if technical data indicated that these materials were in fact recyclable while the alternatives were not. Economic incentives for improved materials use behavior could include taxes on virgin materials and subsidies for using recycled materials. It is important to pair incentives and disincentives together across the life cycle of a specific product to ensure waste minimization across the board for existing products as well as new products. To assist the impacts of regulatory and economic instruments, Eco-Labeling and Certification schemes could assist in providing information about products that meet the highest standards with respect to materials recycling and recyclability.

B. Use and Refurbishment

Carpet tiles are one of the shorter lived products of the built environment, requiring replacement in as little as 5 years in heavily trafficked areas such as corridors. It could well occur that carpet tiles are replaced 8 to 10 times over the life cycle of a 50-year building. Consequently, carpet tiles must be designed for easy removal and replacement to minimize their impacts. Keeping carpet tile waste out of landfills must be a primary objective of policy instruments at this stage of the building cycle. The general rules would be to require contractors to extract used carpet tiles and return them to the manufacturer or, in fact, any manufacturer, for refurbishment and/or recycling. When replacing materials, the same incentives and disincentives that exist at the construction

stage would occur once again. Closing materials loops must also include incentives to set up the logistics of moving materials from tens of thousands of building sites back to the manufacturer. Interface's strategy is to create products of service, for example, through their EverGreen Lease program, in which they retain ownership of the carpet tiles while leasing the service of the carpet tiles to the user. A similar strategy could be employed for many building components, with the manufacturers retaining both ownership and responsibility for building products. This type of activity could be encouraged via economic instruments that would provide tax credits for products of service utilized in buildings.

C. Demolition/End Use

Demolition waste comprises the bulk of the construction and demolition waste stream from construction. In the U.S., of the approximately 145 MMT of construction and demolition waste, 92% of this waste stream is connected to demolition activities. To return products to their manufacturers for use as raw materials for new products, it is necessary to ensure that the removed materials are as clean as possible in order to maximize the 'recycling potential' of the waste materials. This generally implies an orderly process of buildings disassembly, a process of 'deconstruction' rather than demolition in which the materials of the former building are all commingled. Consequently, policy instruments that require deliberate disassembly of buildings are needed to ensure materials are removed in as high quality a condition as possible. The primary regulatory instruments would require two actions: (1) the storage of disassembly information in the building, and (2) the provision of adequate time in the permitting process to allow building disassembly. The latter could be implemented by requiring delay times after application for a building demolition permit. Economic instruments for this phase would include increasing the cost of disposal of demolition waste and providing incentives, perhaps in the form of subsidies, for entities that set up deconstruction, recycling, and/or materials reuse businesses. Information instruments could include Eco-Labeling schemes that have as one of their criteria the ability to disassemble products into recyclable materials.

	Design and Construction		Use and Refurbishment		Demolition/End Use	
	Consumers	Producers	Consumers	Producers	Consumers	Producers
Regulatory Instruments	*Require builders to use a minimum level of recyclable and recycled content materials	*Life cycle responsibil i-ty for producers, for example, Interface's "Solenium", *Technical standards, requiring that carpet tiles be manufactu red from highly recyclable nylon 6	* Require contractors collect carpet tiles and return them to producers *Landfill ban *Require contractors to use materials that are recyclable	*Require producers to take back used product and waste product and recycle it	* Require contractors to collect carpet tiles and return them to producers *Landfill ban *Require contractors to use materials that are recyclable	* Require producers to take back used product and waste product and recycle it
Economic Instruments	*Tax credit /reduced building permit fees for builders who use recyclable flooring *For owner possible property tax credits	*Tax on use of virgin material *Incentive for use of post-consumer waste * Subsidies for take-back scheme	*Reduced permit fees for used recyclable and recycled content materials *For owner possible property tax credits	*Landfill tax *Reduced fees for contractors who recycle existing materials	*Incentives for using post-consumer materials in product ex. Collins & Aikman's Powebond ER3	* Landfill tax
Information Instruments	*Eco-labeling *Informati-on campaign to explain certification and labeling schemes	*Certificat ion scheme	*Eco-labeling *Information campaign to explain certification and labeling schemes	*Certification scheme	*Eco-labeling *Informatio n campaign to explain certification and labeling schemes	*Certif-ication scheme

Table 4. Application of Policy Instruments to carpet tile manufacture, use, and disposal.

VI. SUMMARY AND CONCLUSIONS

In summary, waste minimization and resource conservation can be achieved by designing policy instruments that will help industries develop life cycle approaches to their products both in design for reuse, recycling, refurbishment, and deconstruction. The legal profession can provide the expertise needed to craft an array of intelligent and flexible policy instruments that cover the broad range of issues that affect the supply chain of construction--from raw materials extraction through use and disposal. The carpet and flooring industry is a good example of how companies can simultaneously design for the environment and be economically successful, by reducing their consumption of virgin materials while

developing technology to reuse their products. When designing policy instruments, utilizing the industrial ecology model will enable governing bodies to encourage that existing products will be diverted from the waste stream and become resources, while new products will be designed to contain post-consumer materials as well as to be reused and recycled into new products in the future. Of course, policy instruments must target both the producer and consumer groups to ensure that all stakeholders are similarly motivated to make a material choice that will minimize waste and reduce resource consumption.

THREE QUESTIONS FOR AGRICULTURE ABOUT THE ENVIRONMENT*

J. B. RUHL**

Table of Contents

I. INTRODUCTION

As a plenary session speaker, I have been asked to address three overarching questions about the agriculture industry:

1. Where is the agricultural industry sector in the development of environmental responsibility?
2. How will becoming green ultimately aid agricultural industry development?
3. How can the law help influence the green development of the agricultural industry sector?

Good questions indeed. In the concurrent panels on agriculture later today and tomorrow, you will hear about conservation easements, the environmental impact of raising animals for human consumption, clam aquaculture, total maximum daily loads, and restoration of the Everglades. These are all topics that pertain to the three theme questions, particularly for agriculture in Florida. But, like much of farm policy, they are actually quite limited in focus, playing to local interests and narrow industry sectors. They are pieces of the agriculture-environment policy puzzle, but they

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* Plenary speech, delivered February 14th, 2002 at the 8th Annual PIEC, University of Florida.

** Professor, The Florida State University College of Law, Tallahassee, Florida.

miss the big picture. Most of agriculture-environment policy is pitched at this level because we have simply forgotten, or remembered to forget, to ask the conference's three theme questions frequently and pointedly. In other words, we need to think about the environmental law and policy of agriculture at more holistic levels. Thus, following a few very brief observations about agricultural policy and the agricultural industry, I offer my perspectives on how each of the conference's three theme questions has been obfuscated by past and current policies, and how it might be rediscovered in a new light.

II. A PRIMER ON AGRICULTURAL POLICY AND THE AGRICULTURAL INDUSTRY

As I lament our failure to direct the three theme questions of the conference toward agriculture, am I suggesting that we do not have a coherent policy theme for agriculture and the environment? Not at all. We do have, and have for a long time had, a very clear policy that has become deeply entrenched in national, state, and local politics and law. Recently, EPA Administrator Christine Whitman summed it up as concisely as I've ever heard in a speech before a forum sponsored by the *Farm Journal*, proclaiming that "We can't harm food production to implement food protection."[1] Substitute "environmental protection" for "food protection" and you have our national environmental policy for agriculture, as well as that of most states. In fact, substitute just about anything in there—worker safety, taxes, antitrust laws, minimum wage laws, labor laws, bankruptcy laws—and that pretty much sums up our policy on the topic for agriculture. And this "no harm" premise has been the bedrock of agriculture policy for decades regardless of which party was in control of Congress or the White House.

Consider how it would sound, though, for the EPA Administrator or another federal or state agency head to make the following declarations about other industries. Just pop in the following pairs for *A* and *B* in this sentence:

1. Susan Bruninga, *Whitman Urges Partnerships to Boost Environmentally Friendly Farm Economy*, 32 ENV'T REP. 2317 (2001).

We can't harm *[A]* to implement *[B]*.

A	***B***
nuclear power production	public safety protection
petrochemical production	water quality protection
mall development	wetlands conservation
auto industry production	engine fuel efficiency
steel industry production	air quality protection
medical industry profits	patient care protection
garment industry production	child labor protection
mining industry production	worker safety protection

Not so pretty, are they? Imagine the public uproar that would follow any such statement. So why make the statement about farms, and why no uproar when it is made?

One objection farm advocates are sure to make to this comparison is that these industries are fundamentally different from farming. They are *industries*. Well, so is farming. Farms cover over 930 million acres of the United States, with roughly equal divisions of cropland and pastureland accounting for the vast majority of that total.[2] The total market value of agricultural products sold by farms in 1997 was just under $200 billion, and total expenses were over $150 billion. Within those large parameters, farms represent a vast diversity of attributes. For example, roughly half of the farms generate annual product values under $10,000, accounting for less than 1.5 % of total farm production value, whereas roughly 3.6 % of farms generate over

2. These data for the nation and Florida are from the NAT'L AGRIC. STAT. SERV., U.S. DEP'T OF AGRIC., 1997 CENSUS OF AGRICULTURE (1999), *available at* http://www.nass.usda.gov/census/census97.

$500,000 in annual product value, accounting for over 56 % of total farm production value. Over half of farms are under 500 acres in size, whereas only 4 % are over 2000 acres in size. Over 85 % of farms, mostly the so-called "small farms," are owned by individuals or families; corporate farms make up under 5 % and partnerships just under 9 %. The four principal crops, in order of acres in production, are corn, soybeans, hay, and wheat. The principal livestock, in order of production value, are cattle, poultry, and hogs. As a point of reference, in 1997 farms in the United States produced over 98 million head of cattle, 366 million egg layer chickens, 6.5 *billion* broilers and meat chickens, and 61 million hogs. Farms had an estimated total market value of over $110 billion in machinery and equipment in 1997. They spent a total of over $6 billion on gasoline and other fuels, over $28 billion on chemical fertilizers, crop control chemicals, and other agricultural chemicals combined, and over $2.75 billion on electricity. The payroll for farms in 1997 was over $14 billion for hired farm labor and over $2.9 billion for contract labor.

Florida agriculture is representative of these characteristics:

number of farms	34,799
total acres of land in farms	10,454,217
total acres of harvested croplands	2,435,702
total acres irrigated	1,862,404
avg. acres per farm	300
avg. value of land and buildings per farm	$662,538
avg. value of equipment per farm	$40,869
avg. agricultural revenue/yr per farm	$172,550
avg expenses/yr per farm	$126,043
percent below $10,000/yr revenue	57.5
percent above $100,000/yr revenue	14.8

In short, farming is a vast industrial complex in the United States and in Florida, not to mention the tremendous industries that supply and are supplied by farms. The three theme questions guiding this conference are as pertinent to agriculture as they are to the petrochemical industry. As I show in this paper, however, the problem is that the answers that keep coming out of the policy box for agriculture are remarkably different than for other industries.

III. REFLECTIONS ON THREE QUESTIONS FOR AGRICULTURE

To the extent the conference's three theme questions were being asked about *any* industry in the 1970s, it would not have made much sense to focus on agriculture at that time. Other industries presented far worse problems, and policy triage required that they be addressed first. Today, however, many other industries have dug their way substantially out of their environmental holes, and

people are beginning to ask questions about farms like those this conference has posed.

A. Where is the Agricultural Industry Sector in the Development of Environmental Responsibility?

The best way I know how to address this question is by examining how the agriculture industry is performing in terms of environmental impact. Just a few "factoids" pertinent to that topic paint a rather distressing picture:[3]

- 930 million acres of habitat have been converted to farming uses
- farming practices are converting to mono-culture and total-area cultivation
- 25 % of all cropland has become highly erodible
- 2 billion tons of soil are eroded annually from farms by wind and water
- 331 million tons of eroded farm soils empty each year into the Gulf of Mexico alone
- 55 million acres of cropland are irrigated
- 48 million acres of cropland have become saline, most due to irrigation
- 750 million pounds of pesticides are released annually
- farms produce 200 times as much animal waste as the nation's human waste
- Maryland's 300 million chickens produce 720 million pounds of waste annually
- farm runoff releases 1.16 million tons of phosphorous into the nation's waters each year
- farm runoff releases 4.65 million tons of nitrogen into the nation's waters each year
- ammonia from hog waste releases 179 million pounds of nitrogen into the atmosphere each year in North Carolina alone.

Where does all this put farms in the overall environmental responsibility department? After all, one could amass some rather startling statistics about pollution from a variety of industries. Put in context, however, agriculture is still a major source of environmental harm. Indeed, agricultural nutrient, pesticide, and sediment pollution is the leading source by far of impairment of our nation's lakes, rivers, and estuaries.[4] The impact of irrigated

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3. These data are presented in more detail in my previous work, J.B. Ruhl, *Farms, Their Environmental Harms, and Environmental Law*, 27 ECOLOGY L.Q. 263 (2000).

4. OFFICE OF WATER, U.S. EPA, NATIONAL WATER QUALITY INVENTORY 1994 REPORT TO

agriculture on water supplies in the western states is unsurpassed by any industry.[5] The vast majority of Florida's cropland remains heavily treated with pesticides, with no downward trend in sight.[6] Suffice it to say that, based on relative performance, agriculture has worked its way to the bottom of the list in many respects as other industries have strived to work their way up. And we are well past the days when environmental policy triage leaves agriculture out of the operating room. The spotlight now is on agriculture.

B. How Will Becoming Green Ultimately Aid Agricultural Industry Development?

The second conference theme question just doesn't compute in conventional farm policy, because, despite all the evidence that agriculture is one of today's most significant sources of environmental injury, the agriculture industry *already* is green. Didn't you know that? Secretary of Interior Gale Norton does. Addressing the question of western grazing policy, she recently proclaimed that "farmers and ranchers are often the best stewards of the land. We can achieve more by working with them–and capitalizing on their intimate knowledge of the land they depend on–and the land they love."[7]

This is the mantra of the "first stewards of the land" rhetoric of agricultural policy. The basic argument is that because farmers "depend" on their land, because they "know" and "love" their land, they are environmentally benign or, even better, a positive environmental force. All we need to do is let farmers do the thing that comes naturally to them, that flows from their love for and knowledge of the land, and everything will be all right.

Being dependent on something, however, does not necessarily guarantee stewardship. The fishing industry is dependent on fisheries, but has depleted many to unsustainable levels. One has to bear in mind that when speaking of agriculture, over 900 million acres of our nation's land that are now in agricultural uses at one time were not. They were at one time undisturbed wildlife habitat. It is agriculture that removed trees and other vegetation, drained the wetlands, and leveled the soils. Historically, agriculture has been, if anything, the first *converter* of land. As for "stewardship" after that, how are we to count depositing fertilizers, pesticides, and

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CONGRESS EXECUTIVE SUMMARY (1994).

5. COUNCIL FOR AGRICULTURAL SCIENCE AND TECHNOLOGY, THE FUTURE OF IRRIGATED AGRICULTURE (1996).

6. *See, e.g.*, FLA. AGRIC. STATS. SERV., CITRUS CHEMICAL USAGE (2000).

7. *Norton Calls for Incentive-Based Species Program*, ENDANGERED SPECIES & WETLANDS REP., Mar. 2001, at 3.

animal wastes on the land, exposing soils to wind and water erosion, sucking water out of rivers and aquifers, and all the other traits of modern farming? And regardless of how well they care for their land, the bottom line is that farming has significant adverse offsite impacts, as runoff and wind carry pollutants, wastes, and sediments to distant lands and waters. This is stewardship of the land?

Nevertheless, the answer to the conference's second theme question is complicated by the fact that the agriculture industry is convinced it is green enough, that it has been the first and best steward of the land. The farm lobby uses this complete fiction to justify their position that any further "greening" of farming should be at taxpayer expense. For example, in his recent defense of proposed bloated farm subsidy legislation, the President of the American Farm Bureau Federation stated that "[f]armers want to *continue* to be good stewards of the land, but they need the financial assistance provided in this bill to help offset the costs of new [environmental] regulations."[8] Convincing farmers that getting greener will be good for them, and that they should bear any of the cost, is going to be a difficult task. They associate getting greener with higher costs and tougher times. And, notwithstanding the hope and good intentions that lie behind the conference's second theme question, farmers have every reason to believe that will be the case. It was the case, after all, for every other industry that has undergone environmental regulation.

To be sure, there is a growing number of examples of the "green-green" phenomenon—cases in which getting environmentally greener actually yielded higher financial green. But these cases generally are found in those other industries, industries that have already gone through a long phase of paying dearly for environmental greening. Believe me, no one in the steel industry, or the petrochemical industry, or the power industry, looks back on the growth of environmental regulation in the 1970s and 1980s as having been a big plus for the bottom line. Today, however, now that these industries have passed through the massively costly initial greening phase and into the "second generation" of environmental policy, there are numerous instances in which environmental efficiency and production efficiency go hand in hand, such that green-green outcomes really do happen.

Alas, the agriculture industry is not there yet, because it hasn't yet entered even the "first generation" of environmental policy. Its

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8. Bob Stallman, *Subsidies are Justified*, USA TODAY, Jan. 15, 2002, at 12A (emphasis added). Mr. Stallman did not specify to which purported environmental "regulations" he was referring.

growth in this respect has been stunted by widespread industry advocacy and government endorsement of the "first stewards of the land" rhetoric. Even in the more environmentally mature industries, green-green outcomes are infrequent. Companies devote considerable effort to finding them. Any hope that they will be frequent along the road to greening agriculture is dangerously naive, perhaps even irresponsible.

The bottom line is this: If we are serious about developing the first generation of a coherent positive body of environmental law and policy for agriculture–one that actually acknowledges and mitigates the environmental harms agriculture causes–we need to accept that it is going to cost dearly. Who pays the costs, of course, is another matter-which leads us to the final theme question.

C. How Can the Law Help Influence the Green Development of the Agricultural Industry Sector?

I do not mean to suggest by my previous statements that we should ignore economic efficiency when formulating the first generation of environmental policy for agriculture, but only that the initial slug of law designed to green the agriculture industry will be costly. To complicate matters, it will be very difficult to incur these costs while living up to the "no harm" policy embodied in Administrator Whitman's policy declaration and followed for decades of agricultural policy. We find ourselves, as a result, in the seemingly intractable position of having (1) afforded farming a virtually complete safe harbor from environmental regulation, and (2) paid farmers to do what little we have asked of them on the way toward greening their industry. In short, while other industries operate under a "polluter pays" ethic, agriculture operates under a bizarre "polluter gets paid" policy. Now, as we begin to realize that some very serious improvements are needed in the environmental performance of agriculture, this legacy of safe harbor and subsidy will haunt us relentlessly.

1. The Safe Harbor Problem

The first element of the "no harm" policy is that, whenever possible, farms should be protected from the effects of programmatic environmental regulation–air, water, and other pollution control regulations designed to apply across the board to industries. Farms are either specifically excluded from such legislation, or subtly left out of the regulation's sweep. This system of active and passive "safe harbors" includes, to name a few:[9]

- exemption of irrigation return flows from Clean Water Act permitting
- exemption of farm stormwater runoff from Clean Water Act permitting
- exemption of "normal farming" from wetlands protection laws
- exemption of "normal farming" from chemical release reporting laws
- failure to include farms in most state air pollution control implementation plans
- protection of farming from nuisance claims

Farms, in other words, have hardly felt the brunt of what other industries have experienced since the major federal and state environmental legislation began in the 1970s, and this has been *by design*. Small wonder that farming now ranks among the most polluting of industries.

2. The Subsidy Problem

The second element of the "no harm" policy requires that someone other than the agriculture industry pay the costs of the embarrassingly small amount of greening that has been expected of the agriculture industry in exception to the first element. Indeed, the meager accomplishments that agricultural policy has made toward greening the agriculture industry have managed to abide by the "no harm" policy through a remarkably straightforward technique—we don't simply pass the costs off to another industry or the government, we actually pay farmers to do the right thing. The greening of agriculture has been, in other words, a gravy train for agriculture.

So-called second generation environmental policy advances the use of "incentive-based" regulatory instruments such as market

9. These and other farm safe harbors from environmental regulation are detailed in my previous work. Ruhl, *supra* note 3.

trading programs and sliding scale taxes. But these programs all involve a negative incentive embedded in a regulatory context; the incentive is in how the regulatory impact might be dampened depending on the actor's behavior. When used in the agricultural policy context, however, "incentive-based" is a euphemism for outright *subsidy*. Virtually every environmental accomplishment farm advocates point to as evidence of the greening of agriculture is packaged in a positive-incentive subsidy payment—the so-called "green payments" programs—and most of the policy proposals for more greening of agriculture are derivations on that theme.

Indeed, perhaps the biggest obstacle in the way of intelligent answers to the conference's three theme questions for agriculture is our nation's hopelessly byzantine farm subsidy program.[10] The public is outraged over recent news that Scotty Pippen and Ted Turner receive farm subsidies; it ought to be outraged not over *who* receives them, but *why*. What began as an emergency income support and food security program in the Depression era has, after decades of commodity interest lobbying, become an annual $20 billion entitlements program.[11] And although Florida ranks 36th in overall farm subsidy support,[12] the U.S. sugarcane commodity sector, for which Florida is the top producing state, receives disproportionately large price supports.[13]

While we tried to end farm subsidies a few years ago with the "Freedom to Farm" program, we failed. Indeed, farm subsidies have grown to new heights.[14] So, I will accept the political reality that the law, if it is going to do anything in the short term on the greening front for agriculture, ought to focus on transforming the farm subsidy program into a more comprehensive, rational green-payment program.

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10. For an excellent history of the emergence of the farm subsidy program, see Anne B.W. Effland, *U.S. Farm Policy: The First 200 Years*, AGRIC. OUTLOOK, Mar. 2000, at 21.

11. NORMAN MEYERS & JENNIFER KENT, PERVERSE SUBSIDIES 44-50 (2001).

12. Mike Schneider, *Florida No. 36 in Farm Subsidies*, TALLAHASSEE DEMOCRAT, Sept. 10, 2001, at 5B.

13. MEYERS & KENT, *supra* note 11, at 47.

14. *See* Thomas Fogarty, *Freedom to Farm? Not Likely*, USA TODAY, Jan. 3, 2002, at 1B.

IV. CONCLUSION – WHERE TO GO FROM HERE

Let us leave reality for a moment and suppose a world in which the "no harm" rule is suspended, so that we can speak of greening agriculture without having to limit our field to voluntary programs and green payment programs. What path should the environmental law of agriculture take?

I would not argue for a moment that the appropriate response to that question is to treat agriculture like the steel industry for purposes of policy design. Farming is a geographically dispersed and highly variable industry, which will greatly complicate any effort to regulate and monitor farming practices as we do for most other industries. Also, the vast majority of farms are fairly marginal economic operations, suggesting that at some point added regulatory burdens will indeed have the effect of driving some farms out of business. On the other hand, this was true of many other industries that weathered their first generation of environmental regulation while agriculture watched from the sidelines. And the nation's agriculture industry has grown far beyond our nation's food needs; rather, today the industry is so interested in chasing export markets-markets in which it is not always the most efficient competitor-that its economic swings are tied primarily to prices in *other countries*.[15] The question, therefore, is whether we have the political will to cause the farming industry some pain, but the ingenuity to do so with some sense of efficiency.

Recently, I spent several long days with over thirty people representing a broad, bipartisan array of interests in agricultural policy brainstorming answers to these issues. The World Wildlife Fund and American Farmland Trust sponsored our work. Participants included farmers, policy analysts from the U.S. Department of Agriculture and various state and local agriculture agencies, representatives from environmental groups and policy analysis organizations, agricultural consultants, agricultural lenders, and academics from a variety of disciplines. Three very broad but instructive themes emerged from our work.[16]

First, we agreed that any agricultural policy for agriculture must satisfy four criteria, which we dubbed the "four-sided pyramid." The policy must promote, or at least not undermine: (1) productive efficiency; (2) economic viability; (3) social responsibility;

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15. As Farm Bureau President Bullard put it, "farm producers will not see a big increase in their income this year. One reason is farmers continue to face a stagnant export market." Stallman, *supra* note 8.

16. For a complete report of the session's work, see WORLD WILDLIFE FUND ET AL., WORKSHOP PROCEEDINGS, THE MIDWEST REGION COMMODITIES AND THE ENVIRONMENT WORKSHOP (2001), *available at* http://www.farmlandinfo.org/MCRE_Workshop.

and (4) environmental compatibility. This, of course, sounds very much like the "green-green" outcome I contend will be so elusive for the greening of agriculture. But I took it as a victory that environmental compatibility wound up as one of the co-equal four sides. And surely these criteria are the right criteria for testing any agricultural policy, the difficult issue being which criteria is most important when not all can be served.

Second, we identified five major structural obstacles to achieving the four criteria. The first is that the farming industry has become overly specialized. Subsidy programs favor certain crops. Markets for alternative crops are poorly defined as a result, and it is financially risky to diversify. Growing corn in the midwest is a no-brainer, but what if a farmer wants to branch out? Good luck. Another obstacle is that the agriculture industry is concentrating horizontally and integrating vertically with no real limits in place. Subsidies promote excessive farm enlargement, and the threat of anti-trust prosecution does not exist. Another structural constraint is that farm policy is very difficult to develop in the systems-based model most ecological thinking suggests is needed. The effects of specialization and concentration combine to form a highly fragmented, intensely interest-based industry that makes designing system-wide policies difficult. Moreover, the boundaries of most political jurisdictions bear little relation to the geographical reality of the environmental impacts of farms, thus exacerbating the challenge of regulating effectively. The final two constraints resonate in the points I have already developed above–that the subsidy programs long ago smothered any sense of "polluter pays" ethic in agriculture, and that farmers are so averse to any thought of environmental regulation that they will resist even innovative, efficient policy proposals.

Finally, we turned to the theme of solutions, which seemed an awesome task given the four competing policy criteria we imposed and the five intractable policy obstacles we acknowledged. Given how prominently the subsidy program loomed as a source of more than one obstacle, we focused attention there. Two compelling threshold themes emerged. First, it is the commodity-based nature of the subsidies that makes them so insidious. Subsidies in general may indeed be a useful policy tool if decoupled from commodities and redirected toward the environment. Second, the long history of the subsidy program has not only agriculture to blame. Consumers seldom complain of low food prices. And farmers have relied, not entirely unreasonably, on the subsidy system to justify loans and make investments. Thus, some equitable means of achieving the proposed decoupling is needed. We thus devised a three-step policy proposal:

1. Phase out commodity-based subsidies, shifting the phased out increments each year to a green-subsidy fund.
2. Offer a one-time commodity subsidy "buy out" to those currently receiving the subsidies, in the form of a bond the recipient can retain for its assured income or trade.
3. Transform green subsidies to expand from their habitat conservation focus to a focus on farm practices, using measures of ecosystem services and best management practices as the basis for subsidy rewards.

We used what little time was left to flesh out these proposals, though we achieved nothing concrete. Having advocated more in the way of regulation of agriculture in the past, though proposing to do so through information and market based instruments rather than blunt command-and-control proposals,[17] I was not entirely satisfied by the workshop's narrow focus on green payments. Yet I could appreciate the inequity of simply cutting off the subsidy program altogether, and the idea of tying subsidies to actual environmental performance is novel and interesting–an improvement at the very least on the current system. In the end, it may be that we never achieve a "polluter pays" ethic for farming, but the workshop proposal does suggest that agriculture may be ready for a "polluter doesn't get paid" policy. That alone would mark the beginning of a new day in the nation's environmental policy of agriculture.

Epilogue: On May 13, 2002, three months after I delivered the foregoing remarks, President Bush signed into law the Farm Security and Rural Investment Act of 2002, also known as the 2002 Farm Bill. Without going into detail regarding the bill's provisions, it amounts to surrender on the issue of commodity payments, leaving the "Freedom to Farm" policy a distant memory, and advances the transformation of green payments toward a performance based program by baby steps at most. Fittingly, when he signed the bill President Bush remarked that "For farmers and ranchers, for people who make a living on the land, every day is Earth Day. There's no better stewards of the land than people who rely on the productivity of the land." The White House, Office of the Press Secretary, Press Release: Remarks by the President upon Signing the Farm Bill (May 13, 2002). Suffice it to say that I would deliver the same remarks today unaltered.

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17. *See* Ruhl, *supra* note 3.

RECONCILING ENVIRONMENTALIST AND INDUSTRY DIFFERENCES: THE NEW CORPORATE CITIZENSHIP "RACE TO THE TOP"?*

GARY S. GUZY**

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I. THE ROLE OF LITIGATION – PROGRESS THROUGH CLASHES

About ten years ago, I was sitting in Federal District Court in Miami, as part of the federal trial team that had sued the State of Florida over pollution in the Everglades. We claimed that the State and the South Florida Water Management District had failed to regulate phosphorus discharges from sugar cane farms that were flowing south and choking the Everglades. The litigation, as some of you may remember, was contentious. The state parties had hired a private law firm to defend them. The firm opposed every single step we at the Department of Justice took and in the process racked up $7.5 million in legal fees, all the more extraordinary because at this time Florida was suffering financially, even to the point of having to cut school lunch programs.

That day, when we went in to federal court to argue the United States' summary judgment motion, had to have been about the most remarkable moment in my legal career. The state parties had raised some 186 separate disputed issues of fact. To our amazement, and also that of the private lawyers defending against our action, Florida's newly elected Governor, Lawton Chiles, advised by his new Secretary of the Environment, Carol Browner, decided that he himself would represent the State at the hearing. I remember he rose before the very distinguished, white-haired Judge Hoeveler, and in his wonderful, folksy, common manner, he ignored

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* Keynote address delivered February 15, 2002 at the 8th Annual PIEC, University of Florida.

** Partner, Foley Hoag, Washington, D.C. Former General Counsel, U.S. Environmental Protection Agency.

the years of contentiousness that had preceded him. He held out his arms and said, "Your Honor, the battlefield is littered. Here is my sword. I concede that the Everglades are polluted, and I agree that the state will work to clean it up."

Now I tell you this story for several reasons. Without that simple act of courage on Governor Chiles' part, I doubt I would have ever witnessed what probably was the most unusual moment in my career when, at the very moment that the *Gore v. Bush* case was being argued in the Supreme Court, I had the opportunity to join President Clinton and Governor Jeb Bush in the Oval Office for the signing of the law that put in place the $8 billion, twenty-five year plan to restore Florida's Everglades. All enacted with substantial agreement from environmental groups, state, federal, tribal and local governments, and competing water users, from sugar cane farmers, to urban water users, to put the natural system not at the end of the pipe, but on a par with all these other demands.

Governor Chiles' action also represents, though, the transformation that I believe that is now occurring in the environmental movement, and in environmental law. The Everglades lawsuit illustrates an absolutely central feature of modern environmentalism; that it relied upon, developed with, and was completely dependent on lawyers and litigation. Without significant pieces of litigation to move the process along, we would not have near the level of public health and environmental protection that we have in this county today. But I believe, and I want to explore this with you this evening and I congratulate all of the Conference organizers, because they have put together not only a wonderful event, but one that touches a critical topic at a critical time. I believe that we are in fact entering a new phase in environmentalism, where clashes of views, as typified by litigation, are in fact of less consequence overall, and where industry and the environmental community are nearing a convergence, perhaps even a harmonic convergence, on the need to vigorously defend public health and the environment.

Let's think back for a moment to the beginning of the modern environmental movement just over thirty years ago in 1970. Public protest was becoming more common over issues such as the war in Vietnam. Public consciousness on environmental issues was exploding, as air inversions turned city skies black and threatened lives, and America's rivers literally caught on fire. Congress for years had been trying to move states along to address these issues, but was growing increasingly frustrated. And then, spurred on by the first Earth Day, in the early 1970s in a burst of bipartisanship, Congress enacted sweeping, fundamental new legislation: to establish a strong federal role in protecting the nation's air and

water; to put the country on a path toward protection and cleanup; to regard "polluters" and "pollution" not simply as a byproduct of our industrial age, but as at fault and intolerable; and to set forth the goal of reducing emissions to zero.

II. THE DAMPING OF THE PENDULUM

The most important feature of that legislation, namely the clarity and absolutism that characterizes it, was only fully settled, in a critical Supreme Court decision, just last year, after some 30 years of application. Three features of these laws stand out, and have in fact been essential to the progress that has been made in this country in protecting public health and our environment. The case, *American Trucking Ass'n v. Whitman*,[1] was actually argued in the Supreme Court on the day of the last presidential election, and then decided last spring by a vote of 9-0, in a decision authored by Justice Scalia. It upheld EPA's decision to strengthen ozone and particulate matter National Ambient Air Quality Standards against a broad-scale industry attack, including charges that the Clean Air Act violated the Constitution's non-delegation doctrine. But the importance of that decision should be to answer, once and for all, any question about the appropriateness of the structure of our basic environmental protections, and I believe it will stand as the most important environmental case in a generation. It affirms a basic approach in the environmental laws: to set protective standards based on the best available science; to review this science at regular intervals; to force the development of new pollution control technologies; and to allow flexibility to find the most cost effective reductions. This approach has proven right time and time again.

Many in industry had long bridled at the idea that the targets under the environmental laws, such as the National Ambient Air Quality Standards for example, could be set based purely upon public health, without the consideration of costs and benefits. In *American Trucking*, they finally succeeded in getting that issue before the Supreme Court. And industry believed they had a receptive audience. Justice Breyer had in fact written about the concerns with whether Superfund cleanups foolishly chased every cancer risk with increasingly exorbitant costs for each final increment of protection not making any economic sense. Yet Justice Breyer himself, in his concurring opinion in *American Trucking*, makes perfectly clear that Congress' absolutist choice from the 1970s made complete sense.[2] First, one could argue about possible

1. 121 S.Ct. 903 (2001).
2. *Id.* at 922-24.

costs and benefits endlessly, with little resolution. How do you value the lost IQ points in a child, for example? Further, the environmental law was consciously set up to force the development of new pollution control technology, and this is an approach that has worked. Thus, arguments about costs really are speculation about new technologies.[3] As Justice Breyer reminded us, the automobile industry said it would be forced to economic ruin in the 1970s if it were required to put catalytic converters on cars, and these have proven hugely successful at a low cost.[4] Similarly, utilities claimed it would cost $1,500 a ton to purge their emissions of sulfur dioxide, and these reductions now trade on the open market at approximately $100 per ton. Simply setting a health-based target protects the public, ensures results, allows industry flexibility in how to actually meet the requirements, and provides the right incentives for industry to develop the solutions.

So too should the idea have been put to rest, as expressed for example by the current Administration regarding global climate change, that science may be too uncertain to regulate. Congress in the 1970s wisely recognized, for the major air and water pollutants, that protective standards could be set to begin our country on the road to protection without further delay, even while on-going scientific reviews continued. This was why the Clean Air Act requires that the level of protection for these pollutants be reviewed every five years. This dual approach was recognized, ironically, by Christie Todd Whitman, EPA's current Administrator, in a speech she gave when she was still New Jersey's Governor. She observed that, "science and policy operate on different time scales . . . policymakers need to take a precautionary approach to environmental protection . . . we must acknowledge that uncertainty is inherent in managing natural resources, [and] recognize it is easier to prevent environmental damage than to repair it later . . . The absence of certainty is not an excuse to do nothing . . . Environmental policy should always be based on the soundest information available at the time."[5]

A large part of my time, when I served at EPA, was spent deterring a full-scale Congressional and industry assault on the Agency seeking to slash its budget, hobble its authorities, tether decisions to cost-benefit analyses, allow new litigation against the agency, and require it to pay for the effect of any of its actions on lost income or property values, regardless of how harmful the action

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3. *Id.* at 923.
4. *Id.* at 922.
5. Christie Todd Whitman, *Effective Policy Making: The Role of Good Science*, address to the National Academy of Sciences (2000).

was that EPA was seeking to deter. These were the goals of Newt Gingrich's so-called "Contract with America" in 1995. But a former Republican EPA Administrator, Bill Ruckelshaus, wisely pointed out that our country's history of environmental protection is best characterized by a "swinging pendulum" where we protect perhaps too vigorously and rigidly, which leads to a reaction of too much slackening, and then back again. Certainly this has characterized Congressional action on the environment over the years. But underneath it all, the notion that protecting our health and environment as an enduring American value always comes back. I have become hopeful the *American Trucking* case is a huge damper on the swings of that pendulum, modulating it to an area of agreed-upon convergence. No longer is EPA seen as "the crucible of everyone's discontent," as it was called on its twentieth Anniversary in 1990, but it is now seen as an important protector of communities, and a valuable resource and partner for industry.

III. A SECOND REVOLUTION IN ENVIRONMENTAL PROTECTION?

While I believe that we now have, after thirty years, wide-spread agreement on the baseline system for public health and environmental protection in this country, I want to turn to what I also think has happened over just the past few years, a no-less significant transformation in the approach of many in the private sector to these issues. Compare what is happening today to where this country was just five years ago, much less in 1970, and I think there are five broad and interdependent trends that are emerging.

First, environmental information and the internet have taken on central importance. Think of the change in technology, some call it the "hyper-web," where everything we now do is linked to interactive information technology. From cell phones to Blackberrys to the Global Positioning System in cars, we are linked in nearly every move to computing capabilities. While we take these changes somewhat for granted, here's what they mean. When I first arrived at EPA, its web page received about 300,000 hits a year. Today, it receives about thirty million hits per month, providing information on companies' releases of toxic chemicals into the environment, the quality of drinking water, or the latest state of its scientific risk assessments. This information has become an important part of our system of environmental accountability. And more of it is reflecting real time continuous emissions monitoring or even remote or satellite-based plume analysis. The same is true for the work being done now by advocacy groups. Environmental Defense's scorecard links this information to localized potential public health impacts. Greenpeace International's web page received some 142 million hits

over the past four years. This has meant that there is an enormous amount of environmental information available to the public, and that information can be readily mustered and advocacy campaigns simply turned on nearly instantaneously. Companies are beginning to recognize that they must operate in a transparent way in this "networked economy," and the more progressive ones are embracing that, making key information available in carefully prepared corporate environmental and sustainability reports. Fifty percent of the world's largest companies, the Fortune 100, now prepare these kinds of reports.

Second, the world's economy is becoming globalized at a rapid pace. More and more companies are operating globally. Whether airplane wings are sourced in Spain, or credit card services are provided in New Delhi, traditional geo-political borders are disappearing for the world's businesses. Actions and information in one place can be instantaneously shared and known across the world and can greatly affect a company's reputation. And global institutions, such as the World Bank, have developed standards in the environmental field that are driving behavior due to how prevalent its funding is for work in developing countries.

Third, market-based systems and incentives have now become widely accepted as legitimate, beneficial approaches to regulation. The concept of the trading of emissions reductions is central to finding cost-effective ways to address greenhouse gases. Companies understand these systems; they thrive on finding new efficiencies.

Fourth, environmental compliance has now become part and parcel of the routine way of doing business for most companies. Many have adopted sophisticated environmental management systems, to assure appropriate reporting, tracking, and to encourage innovative thinking about meeting the environmental requirements. A system known as ISO 14001 has become widely accepted as an international standard.

But perhaps most importantly, these actions are no longer simply about meeting the requirements, many companies "get" that acting responsibly on the environment is critical for their bottom line. It helps them operate most efficiently in their production; it helps them attract the most talented employees; it helps their reputations among customers. In short, many companies now believe that being a good environmental citizen helps to impart shareholder value, what large public companies are all about.

Let me read you a recent statement from a group known as the World Business Council for Sustainable Development. This is a group of Chief Executive Officers of some one hundred fifty international companies, including such leaders as BP, DuPont,

Dow, Shell, and Toyota. They recently put forward the "business case" for sustainable development as follows:

> We define sustainable development as forms of progress that meet the needs of the present without compromising the ability of future generations to meet their needs. . . The business case [for sustainable development] has a financial bottom line. During the five years before August 2001 the Dow Jones Sustainability Index clearly outperformed the Dow Jones Global Index [by] 15.8% to 12.5%. The DJSI consists of the top 10 per cent of companies in 68 industry groups in 21 countries seen as leaders in sustainable development. However, our rationale is not based solely on short-term financial returns. Companies comprise, are led by, and serve people with vision and values. Companies that do not reflect their people's best vision and values in their actions will wither in the marketplace in the long-term. The business case is also an entrepreneurial position: it looks to the next point on the business curve – the point at which business can be more competitive by being more sustainability driven. WBCSD companies intend to be at that point first and to stake it out as their value opportunity.

This attitude has led to a blossoming of corporate-environmental group partnerships, many of them with a focus on the critical issue of global climate change. Ford Motor Company recently gave $25 million to Conservation International to establish the Center for Environmental Leadership in Business. Some thirty-five companies have joined with the Pew Center on Global Climate Change to renounce their former membership in an industry advocacy organization challenging climate change science, and instead assert the need for responsible action. Sophisticated companies are embracing third-party certification of their practices. Home Depot has teamed with Rainforest Action, after years of protest, to end purchases of wood products from old growth forests and to prefer products certified by the independent Forest Stewardship Council. The United Nations has issued its global corporate challenge, the "Global Compact," and other codes of conduct, such as CERES, are widely adhered to. There are now codes for everything from mining to raising bananas. The World Resources Institute, a leading environmental group, has worked with dozens of companies to

pioneer the Global Reporting Initiative, to make environmental reporting as well-understood and consistent (and hopefully more reliable) as financial reporting. And socially-oriented investment funds are also thriving with some two trillion dollars under management, where many fund managers now argue that good corporate environmentalism is a proxy for good and enlightened management overall. The recent World Economic Forum in New York became something of an ode for corporations to find the right balance in helping others and securing sustainability, to ensure that globalization does not become permanently fixed as a negative. Is it surprising that when the leaders of the world's largest corporations gathered in New York two weeks ago, they discussed "The Road to Johannesburg," the Earth Summit conference that will be ten years after Rio this Fall?

Let me give you an example of how powerful this new collaborative approach can be. During my tenure at EPA, we brought in the automobile industry, the oil refining industry, emissions control manufacturers, states, and public health and environmental groups, to craft a plan that would close the Sport Utility Vehicle loophole for emissions, providing the next generation of automobile emissions requirements, and taking dirty sulfur out of gasoline. Actions that in the past had seen huge, drawn out fights, instead became a process that achieved clear and timely public health goals, but did it in a way that accommodated industry's need for flexibility on phasing and timing. In the end, no major litigation resulted to delay these new requirements. You know the story of the Everglades as well. These approaches, built on trust and the belief in the system of public health and environmental protection, and informed by good will in participation, are bound to be the most enduring.

Some may assert that companies take these steps so that they can "greenwash" their questionable practices and as nothing more than public relations stunts. The real test will be whether a company's statement of environmentally protective principles really does get translated into the day-to-day work of all of its employees, "driven into its very DNA," as some say. And no doubt many companies reach this enlightened plane because they want to avoid the negative consequences of failing to act in this fashion, witness Monsanto being characterized as "Monsatan" in Europe where its biotech-engineered corn is spurned as "Frankenfood," leading to the loss of billions of dollars in markets, or AES having to spend hundreds of millions of dollars on hydropower siting issues because of alleged insensitivity to local land impacts.

But this time of transition is very real. We have moved from: the first stage of resistance and opposition; to the second stage of

President Clinton's constant refrain, that "the economy and the environment can go hand-in-hand;" beyond even that, to a third stage that is something very different, where major forward-looking corporations are now beginning to define their strategic opportunity in terms of sustainability and social responsibility, the so-called "triple bottom line" of economic, social, and environmental returns. Many companies now know that they benefit from engaging stakeholders, including non-governmental organizations, at every turn. Many new corporate leaders are now of a generation that came of age at the same time as did the modern environmental movement. And this focus on "corporate citizenship" is only accelerating after September 11th and after Enron. The key question to assess will be: do we ever reach a defining point where the rationale for a strong regulatory state, the failure of the free market in forcing companies to internalize environmental costs, is instead being replaced by a race to the top? That said, even with these changes of huge significance, we must remain vigilant, for a competent governmental environmental enforcement presence ensures consistency and provides the baseline protection in case some companies still don't "get it."

IV. THE FUTURE CHALLENGE

There is a ready test for the effectiveness and legitimacy of this new approach, and it is in how we as a nation face up to the challenge of global climate change. Several trends are combining to make this issue the ultimate test of corporate environmental commitment. First, the science of climate change has been becoming more and more refined and certain. A panel of 1,500 renowned scientists, under the auspices of the United Nations, the Intergovernmental Panel on Climate Change, released several reports last year documenting that human actions causing the release of greenhouse gases have already affected the Earth's ability to regulate its own climate. These scientists predicted that temperature rises are likely to be far greater than previously believed, from five to ten degrees or maybe even higher by the end of this century – perhaps even on the order of from the last Ice Age to the present. And in response to a request from the Bush Administration, the National Academy of Sciences, our nation's premiere science policy institution, endorsed these assessments.

Climate change has also reached a level of public and political consensus that demands a response. The rest of the world is moving forward with implementing the Kyoto Protocol to reduce greenhouse gases, even without U.S. participation. Before September 11th, this was the one area where the public most doubted the Bush

Administration's abilities, and where the environmental community centered their campaign to discredit the Administration's policy reversals. Public awareness on this issue has vastly increased, from a *Time* Magazine cover story, to widely disseminated information on local effects, such as the recent University and National Resources Defense Council study, *Feeling the Heat in Florida*,[6] showing likely flooding with the loss of up to four hundred feet of coastline, wildfires, coral bleaching, and saltwater intrusion in Florida. The effect in Congress has been striking. Republican Senator John McCain has joined with Democratic Senator Joe Lieberman in calling for a prompt U.S. response on climate change, and even so stark a Kyoto opponent as Senator Robert Byrd of coal-producing West Virginia has said that the United States must act. September 11th also reaffirms how interdependent the nations of the world are.

Without meaningful governmental action on global warming, how can companies based or operating in the United States engage in long-range investment decisions without knowing where this country's climate policy will take them? How can United States companies who operate globally take maximum advantage of the most cost-effective approaches to reducing carbon emissions within their operations across the globe? Many companies have, in fact, moved well beyond where government currently is on this issue. Some, like BP, have adopted explicit carbon reduction goals similar to the Kyoto requirements. Others, such as Shell, are accounting for future greenhouse gas costs in all of their investment decisions. Others are working with the environmental community to pioneer emissions monitoring and verification systems. But until they break with the Administration and endorse U.S. compliance with the Kyoto mechanism, and as they bridle against strengthened Corporate Average Fuel Economy standards, then fair questions may be raised about the integrity of these commitments. Where the Administration's approach, announced by President Bush yesterday, would allow for a significant growth in greenhouse gases, perhaps by even thirty percent over 1990 levels; where the Administration continues to question the science of global climate change; where despite whatever incentives they have proposed for energy efficiency, the Administration still advocates for some $17 billion worth of fossil fuel incentives in its Energy Plan; where the Administration would actually weaken existing clean air environmental protections, it is even clearer today that private sector leadership will be more crucial without responsible, engaged government leadership on these fundamental issues.

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6. *Feeling the Heat in Florida*, NATIONAL RESOURCES DEFENSE COUNCIL (2001).

V. THE BENEFITS OF PUBLIC SERVICE

As you think about your future career path, let me commend to you the benefits of public service. Many understand now, better than ever, the importance of giving back to our society. It is impossible to quantify the satisfaction that comes from focusing on issues with larger meaning, on the challenge and fulfillment of discerning what is the right approach or policy, on what serves people and communities best, and in finding ways to be true to your ideals and values. The private sector has unmatched capabilities, as well, for you to keep in mind the contributions you can make. That is why since my service at EPA, I have been working to build a corporate social responsibility practice focusing on the opportunities for progressive companies to deal pro-actively with emerging environmental issues, in an open and collaborative, solution-oriented way. Even though under the scenario I have discussed tonight, the traditional role of litigation may be diminished, the challenges for the role of creative lawyering have never been greater or more stimulating.

Let me return to the story I began with about Governor Chiles' bold act. Governor Chiles' act of "laying down his sword" was memorable as well because it was based, quite simply, on a stand of principle: Doing what was right. That has served as a critical lesson to me. At Governor Chiles' funeral a few years ago, one eulogy captured that spirit in quoting Mark Twain, who said, "if you always do what is right, you will please those who agree with you, and simply astound those who don't."

Best of luck in this exciting new era.

A PUBLIC BENEFIT FUND FOR FLORIDA: CREATING A SUSTAINABLE ENERGY FUTURE FOR THE SUNSHINE STATE

DEB SWIM*

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I. INTRODUCTION

Over the next twenty years, Florida will have to greatly expand its capacity to provide energy services to meet projected growth. The conventional approach to meeting capacity needs is to build new power plants and run new power lines throughout the state. Rather than continuing to center Florida's future on conventional supplies, Florida should focus more on energy efficiency, and renewable and other clean alternative generation. The expert advisors to the Florida Energy 2020 Study Commission recommended that Florida institute an independently administered Public Benefit Fund to make sustainable energy a part of Florida's future supply mix.[1]

II. ENERGY EFFICIENCY

Energy efficiency means using the same or less energy to do the same amount of work. It should be distinguished from "conservation" (energy conservation means doing less with less and energy efficiency means doing the same or more with less). Widespread use of technologies that improve the energy efficiency of Florida's buildings and equipment (both the existing and the emerging fleets) is Florida's cheapest and cleanest energy supply. Both the Environmental TAC and the Public Benefits TAC gave us some great news: *By investing more in energy efficiency for our homes and businesses, Florida can simultaneously reduce total electric bills and power plant pollution, while making the states,*

* Senior Attorney, Energy Program Legal Environmental Assistance Foundation (LEAF), Tallahassee, FL. E-mail *at* dswim@leaflaw.org.

1. The reports of the Energy Study Commission's Public Benefits Technical Advisory Committee (TAC) and the Environmental TAC are *available at* http://www.myflorida.com/myflorida/government/taskandcommissions/energy_commission/technicalReports.html.

energy supply more diverse and reliable. The Florida Energy Commission's expert advisors are not alone in emphasizing the value of efficiency investments. Governor Bush recognized, in August 2001, that:

> Over the next 20 years, Florida will have to greatly expand its energy capacity and supply to meet increasing demand. Yet the cheapest, easiest and fastest kilowatt we generate is the one we can save through efficiencies. There is a consensus on conservation and efficiency, so let us start there.

Most would agree that, when it comes to meeting future energy needs, we should invest in efficiency when that would mean lower electric bills than new power plants. The bill savings available from such least-cost efficiency investments — and the disposable income those bill savings would create — should be high on the list of solutions to Florida's recent economic struggles. Of course, efficiency investments also deliver much more than bill savings. As a zero-pollution resource, efficiency also avoids environmental/health impacts from the power plants and wires it displaces.

Some wonder: if efficiency is really cheaper, cleaner, and faster, why doesn't it just occur without any state investment? Extensive studies by the US Department of Energy and many states have revealed market imperfections and flaws[2] that create significant barriers to energy efficiency investments. These barriers to least-cost efficiency are so throughly documented that Florida, and virtually every other state, has adopted laws that use ratepayer funds for incentive programs to overcome them.[3] These programs use incentives to install efficiency technologies in the existing and emerging fleet of equipment and buildings. The incentives may be provided to both consumers (e.g. home or business owners) and suppliers (e.g. homebuilders; industrial motor dealers) and can be either financial (e.g. rebates) or technical (e.g., design, inspection, or marketing assistance).

Florida's efficiency incentive programs are now designed and delivered by electric utilities. Last year, through electric rates, Florida's consumers invested about $82 million, for utility-designed efficiency incentive programs. These incentive programs are funded through electric rates because efficiency resources cost less than

2. These flaws are also described in the Environmental and Public Benefit TAC Reports.
3. *See, e.g.*, Florida Energy and Conversation Act, FLA. STAT. §§ 388.80-.85, 403.519 (2001).

generating and delivering electricity - i.e., the efficiency technologies the programs install in Florida's homes and businesses displace the need for more costly power plant and power line alternatives. Such investments make economic sense since efficiency is the least cost way to meet Florida's growing need for energy service. Florida's decision to fund efficiency investments through electric rates is clearly wise, but it is equally clear that much more can, very economically, be done.

Florida's efficiency incentive programs are very weak in comparison to other states.[4] *Florida's efficiency programs now aim to install only about one-third of the efficiency technologies that cost less than power supply alternatives.* If utilities can save money by investing in efficiency rather than by generating and delivering power, why isn't that occurring? *Florida's least-cost efficiency potential is obstructed by a fundamental conflict of interest. Utilities, which profit from selling electricity, are called upon to design efficiency incentive programs that simultaneously reduce both consumer bills and electricity sales.* So long as this conflict remains, Florida's least-cost efficiency resources will not materialize — and we will continue to forego electric bill savings and needlessly build power plants and wires. Many other states have removed this conflict so their citizens, families, and businesses alike can receive the economic and environmental benefits of energy efficiency. If the conflict is not removed, Florida's efficiency resources will remain at a competitive disadvantage with power supply alternatives.

To address this conflict, the Public Benefit and Environmental TACs recommended that Florida appoint an independent statewide Efficiency Administrator. Efficiency investments would remain in electric rates, but Florida's efficiency incentive programs would be designed by an independent statewide administrator (who would also arrange, by contracting with others, for implementation of the programs). Utilities would have opportunities to profit from implementing programs designed by, and funded through, the statewide Efficiency Administrator — and could thus remain the primary "customer contact" that delivers efficiency incentives.

Efficiency programs should be designed with ample stakeholder/public input to: 1) maximize bill savings to consumers in ways that enhance reliability and lower environmental impacts; 2) offer efficiency investment and assistance opportunities across a wide range of end-use applications so that all consumers have an

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4. Both the Environmental and the Public Benefits TAC Reports document that utility-designed efficiency programs in Florida fall far short of national averages, and fail to secure efficiency technologies that cost less than power supply alternatives. See Attachment A for details.

opportunity to lower their bills; and 3) devote a portion of their incentives to low income communities. With such an independently administered "Public Benefit Fund," Florida could simultaneously reduce power plants, power lines, and electric bills. Also, Florida's current level of investment in energy efficiency should be increased so that we invest in all the efficiency that costs less than power plants and wires. Public Benefit Funds have already been adopted in more than twenty-two other states. Unlike the current utility-administered system, an independently administered Public Benefit Fund is competitively neutral — a valuable feature even in today's more competitive energy markets.

Without such an independently administered Public Benefit Fund: 1) Florida will continue to build power plants and lines when it would cost less to make our homes and businesses more energy efficient; and 2) Florida's homes and businesses will continue to forfeit the bill savings available from investing in efficiency technologies that cost less than power supply alternatives.

Florida should also improve its efforts to develop and deploy clean alternative energy supplies.

III. RENEWABLE AND CLEAN ENERGY ALTERNATIVES

Florida, a peninsula, with virtually no conventional fuels in-state, now depends heavily on out-of-state energy supplies. Developing renewable and clean in-state supplies (such as solar, hydrogen fuel cells, and sustainable forms of bio-energy) would keep energy dollars and jobs in Florida, and offer tremendous potential to reduce the impacts on health and the ecosystem now associated with energy services. They also present a valuable economic development opportunity for Florida: given our proximity and cultural connections to neighboring undeveloped countries where distributed energy supplies are most cost effective. Florida's future rests on the development and deployment of our in-state renewable and clean technologies — but these emerging technologies continue to face many barriers.

As a policy of prudent energy portfolio diversification and environmental protection, the national government and most states have invested in renewable and clean alternative energy supplies, on both demand and supply side. Florida now funds such research, development, demonstration, and deployment (RDD&D) investments with both utility and university sources. The Public Benefits TAC documents that we now invest far less than other states in such endeavors — comparing Florida's current 0.004 mills/kwh (kilowatt-hour) investment to a national range of 0.02 - 85 mills/kwh. The development of clean alternative energy is also

influenced by the incentives created by state tax, regulatory, and fee structures. The state tax code may well contain loopholes that should be addressed.[5]

Florida's efforts to promote renewable and clean energy supplies are now implemented by many agencies, including the PSC, DEP, DCA, the state university system, economic development partnerships, as well as a variety of regional and local initiatives. Florida's Solar Energy Center (part of the University of Central Florida), one of the nation's premier research institutes in both renewables and high efficiency technologies, now serves as the state's energy research and training center.[6] The Florida Energy Office manages nationally funded initiatives and a virtually depleted oil-overcharge fund. But no state agency or official has clear responsibility for managing, in a "big picture" sense, the development of Florida's native renewable and clean supplies, on both demand and supply side.

To meet these challenges, Florida should: 1) develop a coordinated strategy to such clean energy investments; and 2) invest more in development and deployment of renewable and clean energy alternatives through an independently administered Public Benefit Fund. This effort must include an assessment of the commercial and technical potential and sustainability of Florida's renewable and clean alternatives supplies, to identify and prioritize future funding requirements and priorities. Such reforms are particularly critical given the depletion of the Petroleum Violation Escrow funds that, until now, had been available to operate the Florida Energy Office.

ATTACHMENT A: DEMAND-SIDE RESOURCE PRIMER

Energy supply needs can be met by producing electricity or by reducing the demand for it. Three types of demand-side activities should be distinguished: energy efficiency, load-management, and price responsive load. More often than not, the terms "energy conservation" and "energy efficiency" are used interchangeably, but there are some important differences. As the Environmental TAC

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5. For example, the state tax code now provides a tax credit for an efficiency technology so outdated it would violate the current state energy code, and exempts some of the dirtiest fuels, fuel oil numbers 5 and 6, from the state's petroleum pollutant tax.

6. The Florida Solar Energy Center (FSEC) has received about $3 million/year in operating funds from Florida's State University System -- though a large part of university system funding had been from oil overcharge monies that are now depleted). The FSEC also performs contracted research and training for external sponsors, including utilities, at funding levels that range from six to ten million dollars annually.

report states: "energy conservation means doing less with less and energy efficiency means doing the same or more with less."

Demand side activities use financial incentives and technical services to encourage and assist customers to reduce, or shift the time of, their demand for energy. Broadly speaking, activities directed toward reducing total energy use (kilowatt-hours) are termed "energy efficiency" programs, and those directed toward shifting or reducing use at peak demand periods (kilowatts) are called "load management" (sometimes demand-management) programs. The strategic objective best defines whether a program is an energy efficiency or a load management program, since both program types can reduce kws and kwhs.

Efficiency programs typically focus on installing high efficiency equipment and building practices by offering consumers rebates or low-cost building or industrial system design services. A prime example of a pure load management is where utilities are allowed to cycle on and off individual customer appliances in return for a bill credit. Demand-side activities that use variable price signals to alter consumer behavior, particularly at peak periods, are called "price responsive load" programs. These programs are typically associated with load management more than with energy efficiency objectives.

The demand-side programs designed and implemented by Florida's utilities focus almost exclusively on load or kw reduction. This derives from the Florida Public Service Commission's virtually exclusive reliance on a cost-effectiveness test (the "RIM" test) which counts as a cost the utility revenue reductions which take place when consumers bills are reduced by efficiency improvements. The Public Benefit TAC Report notes that:

> Florida relies more heavily on the RIM test than any other state to limit the scope of utility DSM programs. As a result, Florida spends a relatively small fraction of its utility DSM dollars on improving end-use efficiency. . . Florida's utilities have not aggressively pursued all energy efficiency programs. Energy efficiency was only 24.5% of Florida's total DSM expenditures; compared to 57% of total national DSM expenditures, based on 1999 data.

"INDUSTRY IS FROM MARS, ENVIRONMENTALISTS ARE FROM VENUS: RECONCILING OUR DIFFERENCES ON EARTH." – A UTILITY PERSPECTIVE

PREPARED FOR PRESENTATION BY RICHARD LEHFELDT*; PRESENTED BY GREG NELSON**

Good morning. As our moderator Deb Swim indicated, my name is Greg Nelson and I'm Director of Environmental Affairs for Tampa Electric Company. Those of you who have been involved in the organization of this conference may already know this, but I'm actually standing in today for Richard Lehfeldt, our Senior Vice President for External Affairs. While Richard is far more eloquent than I could ever hope to be, he could not be here today due to a very interesting personal conflict. Richard is up in Ohio watching his son compete in a Junior Olympics fencing competition. Richard sends his regrets and wanted me to tell you that he hopes the conference is a huge success.

Since Richard wrote this presentation based on his own personal experience, and since Deb chose to bring in some props, I decided I needed to use some props of my own. I want you to pretend that this debonair gent (holding up photo of Richard Lehfeldt) is making this presentation.

When Gina Fegan first announced this conference on e-mail to the invited speakers, she used the working title "Industry is from Mars, Environmentalists are from Venus: Reconciling Our Differences on Earth." I wanted to start by saluting its brilliance.

The title, which of course refers to that wonderful book (and its less wonderful sequel) about how differently men and women communicate and the misunderstandings that result from those differing styles, captures perfectly the perennial and often frustrating dialogue between the Energy People and their estranged brethren the Environment People. The missed cues and often divisive dialogue between these two tribes reminds one of George Kennedy's famous line from "Cool Hand Luke": "What we have here is a failure to communicate."

With fleeting exceptions, these two groups have worked together only sporadically and on discrete tasks. The last comprehensive national task that they collaborated on was the Clean Air Act Amendments of 1990. That collaboration was initiated by fiat when the last President Bush (referred to by political aficionados as "41" to distinguish him from the current President) announced at the

* TECO Energy, Senior Vice President External Affairs
** TECO Director of Environmental Affairs

beginning of his term that he would set Clean Air Act reauthorization as a top priority of his administration.

That pronouncement forced the Energy People and the Environment People into the same room for the two years of the 101st Congress (1989-1990) to forge a resolution of issues that had divided them for close to a decade. I (Richard Lehfeldt) was then Counsel to the House Energy Subcommittee, and am here to report that it was a bruising and exhausting two years that produced a largely excellent product, the proof being that neither side was completely satisfied with the end result.

The iron anvil of the Clean Air Amendments of 1990 was the acid rain title, Title IV of the statute, which saw the enactment of absolute national caps on SO_2 emissions and the establishment of an emissions trading regime to establish the value and optimal use of the emission allowances. Once the Battle of 1990 ended, the Energy People and the Environment People retreated to their un-neutral corners with different but very real senses of victory. The Energy People had achieved that rarity in environmental legislation: a fairly clear set of mandates with a market-based enforcement regime. The Environment People had achieved a dramatic, enforceable, and verifiable reduction in key emissions from utility power plants.

The point of this now ancient history is that we Martians and you Venusians can speak to each other, work together, and bring about real social benefits under the right set of circumstances. Since I have been asked to give some "regulatee perspectives," let me suggest a few.

First, contrary to popular perception, we Energy People are not ogres. We are, for the most part, hardworking engineers, businesspeople, lawyers, and accountants creating a vital national resource. The decisions that we make, all under the watchful eye of both our rate regulators and our environmental regulators, balance on a daily basis our twin and often conflicting missions of providing a cost-effective product and an environmentally benign product. In the eyes of many, that balancing act is never quite right, but I know of few people in this industry that do not take extremely seriously the need to achieve that balance.

Second, we will almost always take regulatory clarity over regulatory ambiguity, even if the latter may appear to allow for a more permissive standard. Our industry, the most capital-intensive industry in the world, can ill afford to make the scale of investment decisions we are called upon to make in a regulatory environment that is unclear as to either the legal requirements or the penalties for non-compliance. The divisive and continuing struggle over the

trigger point for applicability of New Source Review is a classic struggle of no-win environmental politics.

Third, industry takes well to, and performs well under, a market-based regime. Again, the success of the Title IV emissions trading program is a prime example of what industry can achieve if given the opportunity. In this regard, it is surprising to me that there are still those in the environmental community who view trading regimes as either a gimmick or a free ride, as witnessed in the continuing debate on this matter in the context of the Kyoto Protocol.

I am not naïve enough to think we have traveled down the road to a point where we Energy People and you Environment People can hold hands and sing Kumbaya over each and every environmental issue (and maybe we never will get to that point), but we can all strive to communicate more effectively. We can do this by stepping back, not jumping to conclusions, avoiding inflammatory rhetoric, looking at issues from each other's perspective, and trying, no matter how painful it might be, to strive for those win/win opportunities even if neither side gets everything they want. Perhaps the current President Bush ("Dubya" or "43" to those of you who are close personal friends) has given us another opportunity to test this cooperative approach with his "Clear Skies Initiative" that was announced this past Thursday.

Thank you for the opportunity to present a utility's perspective this morning.

CONSERVATION ISSUES ON MILITARY LANDS: SOME THOUGHTS ON A FRAMEWORK FOR SUCCESSFUL MISSION INTEGRATION

Est Modus in Rebus

LT. COL. LOUIS J. PULEO*

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I. INTRODUCTION

With the advent of the "environmental movement," or more specifically the spate of environmental laws directly applicable to federal agencies, military commanders must now reconcile two seemingly conflicting missions - national defense and environmental conservation. In the arena of resource protection there can be no more palpable skirmish between competing responsibilities than that brought about by the Endangered Species Act (ESA). Explicitly charged, all federal agencies shall "utilize their authorities in furtherance of the purposes of this chapter by carrying out programs for the conservation of endangered species . . . ."[1] To ensure no federal agent could parse words, thus

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* Lt. Col. Louis J. Puleo, USMC is currently an environmental counsel for the Eastern Area Counsel Office, Camp Lejeune, North Carolina.

1. 16 U.S.C. § 1536(a) (2000); *see also* 16 U.S.C. §1531(c)(1) (2000).

confounding the protectionist function now placed upon the federal sector, "conservation" is defined as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to [the ESA] are no longer necessary."[2] That this duty exists is beyond cavil,[3] although the means and method of achieving conservation are, appropriately, left within the sound discretion of the federal agency involved.[4] Amid such syncretistic hopes, dire predictions flourished: military leaders would be unable to reconcile the duties imposed by the ESA and their organic missions; realistic military training would suffer to the detriment of national defense and would endanger the lives of our combat troops; or, the regulatory burden being so onerous and the regulations so complex, we would witness a rash of military leaders being tried for environmental crimes. While none of these apocalyptic consequences have "come home to roost," certainly litigation has at times been used to threaten national security interests or as a means to protect interests other than conservation concerns.[5] Overall, however, the balance has been struck between these seemingly competing missions.

This presentation will explore some of the elements contained in the more successful programs implemented by the Marine Corps. While it is not intended to be a "paradigm" of essential elements, nor are the programs and ideas outlined limited to the Marine Corps, this presentation is intended to briefly review some conservation management elements, within the context of the ESA, that have proven to be successful. Success is achieved when the military can fully and completely perform its organic mission of national defense while still implementing conservation measures under the ESA. One caveat, despite sound fundamentals, a conservation plan can only be successful if the stakeholders thoroughly understand the missions, roles, responsibilities and, most importantly, how public money is appropriated to and the constraints placed upon the military concerning the expenditure of public funds. While these constraints are not unique to the military, it has been my experience that many sister federal agency representatives are unaware of the technical requirement related to the obligation of money. Thus, the parties involved in the negotiation and implementation of conservation measures must

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2. 16 U.S.C. § 1532(3).

3. *See* Tenn. Valley Auth. v. Hill, 437 U.S. 153 (1978).

4. Pyramid Lake Paiute Tribe of Indians v. United States Dep't of Navy, 898 F.2d 1410 (9th Cir. 1990).

5. *See, e.g.*, Strahan v Linnon, 967 F. Supp. 581 (D. Mass. 1997).

understand the legal and regulatory "drivers" that define how the agency "does business."

II. THE "RAISON D'ETRE" OF THE ARMED SERVICES

The "raison d'etre" of the Armed Services of the United States is simply stated: to prepare, train, and equip its soldiers, sailors, airmen, and Marines to fight and win wars. More specifically, the Navy is "organized, trained, and equipped primarily for prompt and sustained combat incident to operations at sea. It is responsible for the preparation of naval forces necessary for the effective prosecution of war . . . ."[6] Likewise, the Marine Corps "shall be organized, trained, and equipped to provide fleet marine forces of combined arms, together with supporting air components, for service with the fleet in the seizure or defense of advanced naval bases and for the conduct of such land operation as may be essential to the prosecution of a naval campaign."[7] Marines understand that "the primary goal of Marine Corps Leadership is to instill in all Marines the fact that we are warriors first. The only reason the United States of America needs a Marine Corps is to fight and win wars. Everything else is secondary."[8]

III. ENVIRONMENTAL LAWS' IMPACT ON THE MILITARY

Against this warrior culture and the magnitude of the military's organic mission, there appeared an accession of environmental protection laws that imposed requirements ostensibly at odds with the military mission. Of particular concern were those environmental statutes that had the potential to have the most immediate and palpable impact on military training, i.e., The Endangered Species Act and The Marine Mammal Protection Act (MMPA). Due to the fulsome protections granted endangered or threatened species, these statutes had the greatest potential to curtail, limit, enervate, or terminate realistic military training, thus degrading the ability of the military to successfully carry out its organic national defense mission.

The reason the ESA and MMPA have such devastating potential in the short-term is their impact on the military's ability to conduct real-world contingency operations and engage in realistic military training. The presence of an endangered/threatened plant or animal in a training area either grossly curtails or eliminates training. The ability to fight and win wars comes with a price:

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6. 10 U.S.C. § 5062(a) (2000).
7. 10 U.S.C. § 5063(a) (2000).
8. MARINE CORPS MANUAL, 1980 Chg. 3, Para. 1100.1 (1980).

military exercises and training must be done under conditions and in a manner that simulate, as closely as possible, the conditions and effects of actual combat. Military installations, with the associated ranges and training areas, have as a matter of necessity vast tracks of undeveloped land and natural resources. As a consequence military installations have become "de facto" refuges for many species that either retreat to the installation in the face of ongoing "urbanization" of the surrounding community or remain within the species' historic range on an installation that has preserved a favorable habitat. Military training, with the use of weapons, heavy machines, live ordnance and sudden concentrations of large numbers of troops, are considered environmental anathema and have the potential to "take" endangered or threatened species.[9] Thus when commanders must encumber military training or cease such training altogether due to the presence of endangered or threatened species, the primary mission of the military is jeopardized.

However, despite many hardships, the Marine Corps has been successful in balancing the two missions. This presentation will explore some of the characteristics that contributed to that success and is based in large part on the successful Red-cockaded Woodpecker recovery program implemented at the Marine Corps Base, Camp Lejeune, North Carolina..

IV. CAMP LEJEUNE'S EXPERIENCE: THE RED-COCKADED WOODPECKER (RCW) (PICOIDES BOREALIS)[10]

Named for the small red streak (cockade) found on the male of the species, the RCW is a non-migratory bird with an historic range across the southern United States: from Texas to southeast Missouri, extending east throughout Virginia, North and South Carolina, Georgia, and Florida. Due in part to the destruction of favorable habitat, namely more mature pine forests throughout the region and the encroachment of hardwood midstory attributed to fire suppression efforts, the RCW has seen a dramatic decline and is currently listed as an endangered species afforded protection

9. The term "take" is used in this context to include the broad definition of take under § 2 of the Endangered Species Act, i.e., "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." 16 U.S.C. § 1532 (2000). In turn, "harass" is broadly defined as an intentional or negligent act which creates a likelihood of injury to wildlife by annoying it to a degree that significantly disrupts normal behavioral patterns. 50 C.F.R. §17.3 (2001).

10. Much of the information about the RCW is taken from the Camp Lejeune Mission Compatible Plan for the Comprehensive Long Range Management of the Red-cockaded Woodpecker (May 1999).

under the Endangered Species Act.[11] Unique in its nesting habits, the RCW is the only woodpecker that exclusively uses living trees to excavate its cavities. Although thought to prefer the longleaf pine for cavity excavation, the RCW prefers mature trees (over 60 years old), which are usually infected with a heart rot fungus that softens the tree's heartwood. Optimal habitat for the RCW, for nesting and foraging, encompasses a more mature "pine dominated stand" with scarce midstory growth. With optimal conditions, 100 acres of foraging habitat will support an RCW "group." As the quality of habitat diminishes, acreage requirements increase to 200 acres per group as an average.

Home to nearly 150,000 Marines and Sailors, family members, retirees, and supporting personnel, Camp Lejeune is the Marine Corps' foremost east coast training base comprising approximately 151,000 acres. The primary mission of Camp Lejeune is to provide military training facilities and ranges for Marines and Sailors of the II Marine Expeditionary Force. Training activities extend across the Marine Corps' doctrinal fighting posture to include air, artillery, and infantry forces coupled with combat support operations. These training functions are categorized into seven broad classifications: vehicle operations, infantry operations, engineering operations, helicopter/fixed wing operations, Military Operations in Urban Terrain, firing range operations, and combat support operations. Geographically, the base is divided by public highway into two primary areas designated as "Mainside" (approximately 110,000 acres) and "the Greater Sandy Run" area (GSRA) (41,000 acres). Mainside contains approximately 37,000 acres of pine and pine-hardwood forest (the primary habitat of the RCW) and the GSRA has approximately 11,000 acres of pine or pine- hardwood areas.

V. A COMPREHENSIVE PLAN TO PROTECT THE RCW

As of 1999, there were 52 clusters of RCW with 48 active clusters (46 of which contained breeding pairs). All clusters are located on the Mainside portion of the base, with a majority of them located on the periphery of the base's main live fire impact area. Due to the provision of the Endangered Species Act, which created numerous restrictions on training activities in or near identified RCW clusters, consultation with the United States Fish and Wildlife Service (USFWS) has been ongoing. In order to comply with its section 7 responsibilities, base officials sought to implement a RCW management strategy that would promote its conservation

11. The RCW was listed as an endangered species on Oct. 13, 1970. 35 Fed. Reg. 16,047 (Oct. 13, 1970).

mandate, reduce or eliminate restrictions on military training operations and provide for incidental take as needed. A comprehensive plan based upon a biological assessment was developed and approved by the USFWS pursuant to a biological opinion. This plan represents one of the more successful efforts to strike a balance between military training/national defense and the agency's conservation requirements and is a model for ESA implementation on military bases. The plan's comprehensive strategy serves to educate the stakeholders, provides for the inventory of available RCW habitat and training areas, establishes priority training sites given current and foreseeable requirements, establishes Mission Compatible Recovery Goals (MCRG),[12] implements habitat management activities that would achieve the MCRG while reducing or eliminating training restrictions in priority training areas, and adopts the USFWS "safe harbor" concept to a military situation.

While many elements of this plan may not apply to other installations, given the unique nature of the mission, habitat or species involved, or due to other regulatory restrictions associated with the particular species in question, the following elements of the plan present a strategy for reconciling military training/national defense with conservation.

A. Education

Although cliché, education and insight by the stakeholders are fundamental to any successful effort to balance conservation with effective training. What may be a matter of common sense and part of the universal psyche of one organization may be wholly foreign to another. Most Marines, and those associated with the Marine Corps, through inculcation, understand both the Marines' warrior culture and the primacy of training for combat under realistic circumstances through the use of live fire exercises. This necessity engenders from the critical role the Marine Corps plays in being a forward deployed force capable of responding on short-notice, with sustained combat capabilities, to crisis situations worldwide. The grave consequences of this mission and purpose naturally and indisputably compel training that closely imitates combat or near-combat situations- leading to the axiom "we train as we fight." For Marines, this fundamental precept requires the use of those means, systems, weapons, and tactics that are designed to inflict casualties upon the hostile forces. As a foreseeable consequence, however,

12. MCRG recognizes the balance that must be struck between existing and anticipated training needs and conservation requirements of the RCW.

there is an environmental price paid by the use of such measures during training. Related to the Endangered Species Act, that consequence encompasses a "take" as that term is broadly defined under the ESA.

Similarly, for the professionals of the United States Fish and Wildlife Service, conservation and the purposes of the Endangered Species Act are matters of grave importance - in some cases, to those who are entrusted with its enforcement, it is certainly a national priority, if not equal to the military mission. It has been my experience that professionals on both sides do not fully understand or appreciate, in a meaningful way, the roles, missions and functions of the other. This education process must be a hands-on realistic affair. Sitting in the comfort of conference rooms, discussing mission and roles will not lead to a full appreciation or understanding of the consequences and concerns involved. Rather, real understanding only comes when environmental professionals are personally and intimately exposed to military training. Visits to the field, weapons demonstrations, accompanying troops in tactical exercises, and enduring some of the simulated contingencies designed to ensure combat readiness are essential components of the education process. Theoretical discussions with concomitant nods of agreement or understanding do not replace the enlightenment that comes with personal exposure and experience.

B. Review Regional Recovery Objectives

As management and recovery plans are regional in scope, both the USFWS and military planners should understand the contribution the military installation is asked to make in order to achieve regional recovery of the species.

C. Identify Realistic Training and Mission Requirements

The balance that must be struck between reducing or eliminating restrictions on valuable military training sites and the conservation of the particular species in question requires that everyone involved in the process set realistic goals and targets. Congress has mandated that both missions coexist on military installations, but the agencies responsible for implementation must prioritize missions to accomplish the overall objectives mandated. For the military this translates into prioritizing training areas, both current and future. This prioritization is obviously derived from land availability, mission capabilities and needs, current use, anticipated future use, characteristics of weapons employed, and safety concerns. Further designation of priority training areas should be made between "high" and "low" priorities, which allow

some refinement and flexibility to the process. This classification establishes a baseline upon which agency representatives can balance recovery goals with military training needs. The fundamental purpose of classification as a priority training area is to reduce or eliminate training restrictions in those specified areas by managing species populations away from such areas or allowing such takings under the imprimatur of "safe harbor" or enhancement of propagation or survival provisions.[13]

D. Establish Realistic Mission Compatible Recovery Goals

Having identified priority-training sites, recovery goals for an installation would reflect and account for the military mission based upon the availability and quality of suitable habitat. Such goals take into account existing habitat, priority training areas, future suitability, installation land use management plans, current distribution, and training and operational needs. Such goals also take into account both the optimal land available for the species conservation/recovery as well as resource minimums that will support a population with sound management practices. This flexibility would allow planners to "trade" land for best management practices elsewhere on the installation in order to support changes in operational and mission contingencies.

E. Consider the "Safe Harbor" Policy as a Means to Achieve MCRG while Reducing or Eliminating Training Restriction in Priority Training Areas

The "safe harbor" policy, applicable to non-federal property owners, provides for voluntary habitat management activities conducive to the recovery of the listed species in question, with the purpose of increasing available habitat for an endangered and threatened species. In return for favorable resource management, USFWS grants assurances that additional land, water, and natural resource use restriction would not be imposed as a consequence of the conservation efforts. [14] As the Service has no authority to mandate beneficial conservation measures, and private landowners are concerned that any conservation practices would attract or increase the presence of protected species to their land, with concomitant restrictions on take, the "safe harbor" policy strikes a balance between the statutory authority of the Service and the legitimate concerns of the private landholder. It creates an

13. *See* 50 C.F.R. Subpart C (2001).
14. *See* 64 Fed. Reg. 32,717 (1999).

incentive to engage in beneficial resource measures without the corresponding risk to the economic development of the property. Similar in concept, military installations can agree to certain management practices designed to reach the MCRG specifically in those areas that would minimize conflicts with training requirements. This can be done concurrently or in phase, by allowing incidental take in high priority training areas as the population elsewhere is augmented, thus reducing or eliminating training restrictions in critical training areas.

F. Implement a Management Strategy

Incorporate a mission compatible plan that will attain the MCRG yet allow incidental take by the relocation of species away from high priority training areas or the reduction/elimination of training restrictions either in anticipation of population growth or as a consequence of such growth. Identified research areas and recruitment populations can be designated to study the effects of reducing or eliminating training restrictions. Monitoring of effects will allow military authorities, in coordination with USFWS, to fine-tune restrictions and conservation measures to optimize species population growth with the concomitant reduction of training restrictions. Attainment of the MCRG should allow military authorities to eliminate most, if not all, of the training restrictions that still exist. It must be recognized by all parties that this is a long process, subject to successes and setbacks inherent in species population and growth. Immediate results will not be obvious, rather, sustained and incremental conservation and recovery is the objective.

VI. CONCLUSION

While these considerations form a generic construct of an effective management plan, the key factor in success is the understanding each side has with the missions and methods of the other. Innovative measures similar to the "safe harbor" concept, flexibility in implementation, and realistic goals provide the foundation of a successful conservation plan.

PANEL: ETHICAL DILEMMAS: FINDING COMMON GROUND ON CONTROVERSIAL ISSUES

LESLEY BLACKNER,[1] RICHARD C. FOLTZ,[2] ANNA L. PETERSON,[3] BRION BLACKWELDER,[4] LISA C. SCHIAVINATO,[5] ALYSON FLOURNOY[6]

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I. FOCUS OF THE PANEL

This panel discussion applied ethics to the theme of the conference. Panelists examined ways ethics may help reconcile industry (such as business and development) with environmentalism.

II. EXCERPTS OF THE TRANSCRIPT (EDITED, REVISED AND EXTENDED)

MODERATOR: Ms. Blackner, would you begin our ethics panel discussion, and remind us of Florida's state-of-the-wetlands, as you have found it to be, and what efforts you began about it?

BLACKNER: I believe that at least in Florida, a great number of laws which are good laws, are simply unenforced. As a case in point, I agreed to take a case for the Sierra Club and a number of citizens, concerning a road near Tampa called the Suncoast Parkway. I got the documents relating to the permitting of this road as construction commenced. The permitting of this road was like the perfect law school exam: Let's figure out how many

1. Panelist: Attorney, Blackner, Stone & Associates. *See infra* APPENDIX, for full biography.
2. Panelist: Ph.D., University of Florida Departments of Religion and History and College of Natural Resources and the Environment. *See infra* APPENDIX, for full biography.
3. Panelist: Ph.D., University or Florida Department of Religion, College of Natural Resources and the Environment, and Center for Latin American Studies. *See infra* APPENDIX, for full biography.
4. Moderator: Assistant Professor, Shepard Broad Law Center, Nova Southeastern University.
5. Student Assistant: University of Florida, Levin College of Law.
6. Faculty Advisor: University of Florida, Levin College of Law

environmental laws have been violated here. The C answer would be 5, the B answer would be 10, and the A answer would be all of them. My husband said it was like a kamikaze effort to challenge it. It was as if the agencies who were involved had gotten into a room, cut the deal on wetland mitigation, and that was it.

The flip side about the permitting was that the people involved from the citizens side had no clue how the law worked on the permitting process. There are all these different agencies out there, you've got the Water Management District, DEP, Army Corps of Engineers, U.S. Fish and Wildlife Service, the Counties, cities. It's not a user friendly system unless you want a permit, then it's very friendly. And I was so upset that nobody had commented during the public comment period on the permits, when I looked into it. And I was surprised at the extent the environmental movement in Florida did not understand how the Clean Water Act worked. And I looked through the permits which the Army Corps of Engineers issued in Florida, and I realized that they just rubber stamped these permits and that the public had no involvement in the comments or process. I guess like a lot of people I thought this beautiful Clean Water Act is on the books, it must be protecting waters of the United States. But I found, that is not how it works. I began really thinking about things. Everything west of I-95 in South Florida, is historically Everglades, but much or most of that has been dredged and filled since the Act has been on the books for the last 30 years. So, I filed this big law suit. And the Judge did not say, "You're wrong on the merits." What he said, was "Too little, too late." And the legal term for that is "Laches", too little, too late. It's very painful to know, you can be right on the merits, but if you sit there and don't get ahead of your curve, you're going to lose.

The way the system sits, you're probably going to lose anyway. I've become very disillusioned with our government in Florida. What I did with my frustration, with being upset with the Army Corps of Engineers not following its own regulations, was to start going around the state giving workshops to people to explain how these laws work or don't work. My opening spiel is, "Imagine if the Federal government says, 'We're not going to enforce the Civil Rights Act in the states of Mississippi and Alabama. Why? Well because there are too many African Americans in those states!'" Well, in Florida, the Clean Water Act is not enforced. Why? Well, they say, there's too many wetlands in the state! That's where I'm coming from. So I started this web site, Floridasos.com, and I'm now a member of this group, Floridians for Environmental Accountability, whose film was shown to the conference. So you can see where I'm coming from. I believe that government is supposed to be of the people, by the people, for the people. But no, it's of the

developers, by the developers, and for the developers. And I used to think our state government didn't care about us. But now I think it's worse. I think it's dangerous to us. And I'm very angry and I wish I could mobilize people. I know there a lot of people out there who are upset. But somehow we have to harness this anger, and do something productive with it. I'd like to see that anger unleashed on Tallahassee.

MODERATOR: Let's take Attorney Blackner's example, and try to address it in an ethical analysis. Perhaps Dr. Peterson can speak to the underlying assumptions in debates such as this, the general values that begin to apply, and other thoughts flowing from what we just heard.

PETERSON: My training is in social ethics and I approach environmental ethics from that background. One of the things that I try to do is think about the underlying assumptions. What is it that we value? What is the stake of the different parties? It is hard not to be very cynical. But you can come to an understanding and answer, at least partially accurately as nothing is ever definitive, by looking at what's being valued in a case like the one just described. I don't know the parties involved, but there are usually two obvious main ones. The environmental organizations and activists and the lawyers that will be with them, and the industry or developers, or the government agency siding with them. And of course, there are a lot of others. The mistake we sometimes make is thinking there are only two parties. But for simplicity's sake, what is it the main or more in-power side's value? And what are the assumptions that underlie what they are trying to do?

Before becoming concrete on the example, we can focus on the language and context for the different claims and push more beneath the surface, rather than simplify it for developers for example to "all they care about is money" (although that is perhaps true to a large extent). We can still think about why do they value that. Is the value greed, or power? Well, the environmentalists value nature, the state staff value their jobs, which depend on developers, developers value the money they can gain, and that's an accurate answer I think.

Then you can ask why do they value this over this? What are the reasons when reasonable people might say it's very short sighted to value say, short-term profits over long-term environmental health. We might say, gee, that doesn't make any sense. And I think that's where a little ethical analysis can help, because people have a tremendous capacity for self-justification. . . . People have a great capacity to find ethical and moral

justification. People almost never say, "I'm greedy, and that's why I want this." People say "It's jobs that are more important." People value nature, but people value nature in different ways and for different reasons.

And this is where environmental ethics as a discipline offers language about for example, intrinsic versus instrumental values. Valuing nature in and of itself, including what is known as "deep ecology," is called a "biocentric" perspective. This states that the value of a natural place, or plants, or a landscape, or a non-human animal, the value of those is entirely independent of any relationship or utility to humans. Then there are other ways of valuing those that do relate them to humans. There is an endless variety of ways to do this. But while there are reasons that people give for valuing what they value, people may also have reasons that they do not give and even that they are unaware of, which have to do, for example, with what they understand as the purpose of human life. That may sound very abstract, but it is not really, because those abstract questions and those ideas that we may not think about very explicitly, or only in passing . . . Nonetheless, they really shape our actions, and they shape the actions of developers. Even though they may not be thinking about it at all, they have values, and oftentimes their values may not be something particularly noble, and they may not be something that they want to think about very explicitly. It may be selfishness, and there may be selfishness on both sides, too. You can be on the right side of an issue and it doesn't mean that you are necessarily morally flawless.

When we think about what we value collectively, and why we value it, we also want to think how we protect what we value. And understanding why we value what we value, is very important to thinking about how we can protect it. What are the obstacles that can prevent our realizing that protection, or our fulfilling what we want to do? That is why we have to think about strategies, means and ends and the relationship between those.

MODERATOR: Perhaps Dr. Foltz can describe some mistaken assumptions that are made, some of the differential perceptions affecting some of the publicly debated matters.

FOLTZ: Well, Dr. Peterson made a good point, that things are often presented to us (the public) in terms of the two-party system. In other words, the notion that there are two views on a subject, therefore two sets of competing interests, which is almost always a gross oversimplification. There is often a deliberate effort to obscure the complexity of issues so that cases can be made very forcefully and often very emotionally. So I think the most useful

approach, in such cases, is to attempt to deconstruct this polarization. Don't let anybody get away with sharing an unsupported opinion with you. When somebody states their position, ask them to explain it. This is the Socratic method we use with our students. We say, fine, you have an opinion, we all have opinions on just about everything. But how many of us have actually thought through our opinions from beginning to end, recognized and come to terms with the underlying values that have caused us to absorb things in a particular way and to formulate that opinion? I suspect that nine times out of ten, we are comfortable with expressing an opinion without actually having any sense of where we got that opinion, or it may be a very mistaken or unclear sense.

One exercise we like to do with students (often on the first day of class) is have them open the Bible to Genesis 1:28, the verse in which God commands us to be fruitful and multiply, and to fill the earth and subdue it. More than one theologian in recent years has commented that this is apparently the only command in the entire Bible that we've obeyed! It's interesting to think about where we get this notion that we're fundamentally different from all other species. Nobody knows how many species of life forms there are on earth. The leading experts, people like Ed Wilson at Harvard and others who have devoted their lives to counting things like species of insects, they have narrowed it down to anything between 15 million and 150 million, they are pretty sure that is the range. And how many have we actually counted? 1.7 million. There are 1.7 million species that we actually have named and classified, perhaps 11% of the low end or 1% of the higher estimate. We don't know anything about the biodiversity that surrounds us, and yet we're only one species within this huge unknown catalogue of species, so where do we get this idea that we're the one species that matters, that everything else was made for us? In some passages at least, the Bible gives some support to this, but there are other passages (like in Psalms) that kind of round out the picture somewhat. But people tend to be selective in terms of picking and choosing what supports their existing views.

A lot of classroom discussion has to do with having students think through these assumptions. Where did they get these ideas? Why do you just assume automatically that, say, logging jobs are more important than spotted owls? Of course we all know that is a red herring, because those loggers are going to lose those jobs anyway, it is just a question of now or later. But that brings up another issue of how deeply engrained these kinds of culturally informed assumptions are, getting programmed into us from virtually the day we are born. We are not very aware of it but they

are incredibly operative in affecting our thinking. We react spontaneously to things intellectually, but very often on the basis of these deeply buried assumptions. So part of it is bringing them to the surface, into the light of day. Shine the light on your assumptions so that you can examine them and see them for what they are, rather than just taking them for granted.

I work mostly with the developing world, environmental organizations in the Middle East and South Asia and elsewhere, where the underlying assumptions are different. It is often easier dealing with contexts like this, where you can see very clearly there are different value systems, not just one value system which is universal. Living in the United States, it is a little harder to get at that, because a lot of people assume that our commonly shared notions are universal notions and therefore they must be right. I think it helps as a first step to deconstruct that. But then once we've recognized that these sort of diverse cultural assumptions exist, we can start looking at how they get manipulated by people that have a particular agenda. So even though on further analysis it becomes clear that the choice is not between spotted owls and lumber jobs, the idea that the choice could be presented in these terms is only possible given a widely shared cultural assumption that humans are more important than owls.

The media has a lot to do with how these debates get framed. We do not have an independent media in this country--I think that's becoming clearer and clearer to people who watch the media and who are seeing the way it's concentrated into larger and larger and fewer and fewer corporate hands. If, on the other hand, you look at the alternative media and see what is being discussed, you will see that it is a completely different set of issues in many cases. Many of the most important issues never get discussed in our political process, while there is a certain set of issues that keep coming up again and again. The Republicans and Democrats differentiate themselves from each other on the basis of this very limited set of issues, while agreeing at the same time that both parties will completely exclude from the discussion a wide range of other issues which are therefore simply not brought into the public debate and on which it often turns out both parties basically stand in exactly the same place. And that is why the major parties do not want to discuss such issues, because then everybody would see that there is no real debate and people might start calling for some genuine opposition. That is a real problem, and that is where grassroots mobilization is really the only solution that I can see.

In order to make truly informed choices, people need access to a wider range of information than they are getting, the kind of information that is not made available thru the mainstream

channels. I think this is something everybody can play a role in, and I think it is necessary for a true democracy.

MODERATOR: Let's then take it back to our grassroots "prototype." The floridasos.com web site has some assumptions. Some quotes making assumptions in the site are "How was the Clean Water Act highjacked by developers?" or, "The Army Corps of Engineers has only heard consistently from one interest group, developers", or "Florida SOS believes the Corps routinely caves in to developers and will probably view you as a problem, so don't expect much from the Corps in terms of hospitality" or, "The Corps views developers as its clients." These are some of the position-taking there...

BLACKNER: No, those are facts!

MODERATOR: Did you, when you started working on wetlands, believe that was the way it was going to be, or did you learn that in the school of hard knocks?

BLACKNER: I must say when I came out of law school, I had a deep respect for the law. And I went and worked for the Florida Fifth District Court of Appeal for four years, and I believed the system, at least the legal system, the appellate system, worked equitably. And I can tell you that everybody who worked there was fair and open minded. Then I went out into private practice, and I did a lot of nuts and bolts kinds of cases, car accidents and so on, and I thought those were processed fairly depending on how aggressive your lawyer is, but I do think environmental cases are different.

I really believe that, and I've done a few environmental cases, I've taken a few selectively, I have a handout reprinting an article that pretty much sums up what I think about labeling people, and assumptions underlying what we say. But I have learned the hard way. I've been to court on any number of cases and I do believe that judges do look at cases where you are suing the government differently than if you are suing in a car accident case or a contract case or something like that. So my anger built slowly.

I came from the background that you do respect the law, you do respect the government, you assume that we are the preeminent legal system in the world. And our laws are important, and we are an nation of law. I was raised in Jacksonville, in a very southern family. Very deferential to authority. My mother is very southern. My anger has come up slowly. I had to break out of the mold. I didn't start to think for myself until I was 35. In law school, I was

very deferential to authority. But I'm not anymore. Because I don't believe that the laws are being enforced that address the environment.

MODERATOR: You are staking some ground, and I want to go to Dr. Peterson with this. Because Dr. Peterson has written maybe the latest book out in the field, *Being Human: Ethics, Environment, and Our Place in the World*. It was so new, they hadn't catalogued it in the library that I got it from, and I had to get them to hurry it up. From what I've been able to read of it, there is a quote towards the end discussing "Lived Ethics," and you say, perhaps slightly taking it out of context, "We can construct a liveable and lived ethic only in and through a process of listening to others and working with them." But in this tough world that Mrs. Blackner depicted, what features of this process of listening to others and working with them, do we in the legalistic environmental area need to address?

PETERSON: I do think that dialogue and listening to people is important, although I also think that we have to have very limited expectations. And I think that realistic experience of activists in legal and other settings is that sometimes the dialogue is not mature, and should not be listened to and taken seriously.

That can be for a variety of reasons. People may not listen because they are so convinced on either side. More often, the side that is powerful, the people that are powerful, do not have to listen. They do not have the interest in listening to differing opinions. Or in really allowing their assumptions and their actions to be challenged. There is no reason, why should they? The status quo works well for them. For that reason, morally, people in power, whether it is a teacher and a student, or a developer or a small grassroots group, the people that have power have morally a greater responsibility to listen and to be open and to take seriously the challenges of the other. But practically speaking, that rarely happens. So while dialogue and listening and trying to understand each other is important, it is not always fun, it is not always possible, particularly when you are in a sort of David and Goliath situation. It is not always possible to be taken seriously, to have people to acknowledge your claims.

Sometimes it is the case even where people are saying they value the same thing. They say, "But, oh, we value wetlands, too, we just have this trouble protecting them and what we have always done is always sufficient to protect them." People will not engage you at the level you want to be engaged at, by saying, "Oh, we already value that, and this is our way of protecting that, and your way is just an alternative way of protecting them and we've already

taken care of that." So sometimes dialogue is not really possible, although it is important and is a part of what I was saying and Dr. Foltz was saying: we need to deconstruct it and think a little about what is at stake. You can ask if you really value wetlands or nature, or owls or manatees or whatever you say you value.

Everyone says they are for nature, no one says they are not an environmentalist. It is very rare, it is sort of like saying, "I hate babies, *and* I hate spotted owls!" And so everyone is an environmentalist. But do people then support policies that are good for babies or spotted owls? No. Do they always take their personal actions that are good for what they say they care about? No. There is always a gap at the level of individual behavior and at the level of institutional policies.

And those are the people that have a much bigger impact. But even there you can challenge people if you can engage people in a dialogue.

But maybe you have to engage them in that dialogue by a lawsuit or a demonstration or other means to engage people and challenge them. As Dr. Foltz said, "You say you value this. But look, we can prove that your means to protect what you say you value don't work. So then what do you say?" And you can keep pushing.

MODERATOR: Dr. Foltz, could you take this into the legal sphere that has been raised by Dr. Peterson, about engaging in suits and demonstrations or activities and then you get the dialogue and things going. James P. Sterba, an ethical philosopher focused on the environment, says a moral approach to practical problems does not include the legal approach. He separates us out. He says this because a moral approach to do or not do certain things must be reasonably acceptable from the standpoint of everyone affected by them. That is, even if it is not actually accepted by them, it must be reasonably acceptable to everybody that is affected. And I wonder if that is right, then in talking about this, that the law is going to be amoral because not all affected should be expected to find the laws or enforcement acceptable.

FOLTZ: Well, I think it is obvious that a lot of laws are not moral and a lot of things that are moral are not legal. So that is probably the beginning of enlightenment, to realize there is no one-to-one correspondence there. Sometimes to do the moral thing you have to break the law, or work to change the law. I think that when people talk about the magnitude of the challenge that is facing us, we are trying to deal with a political system that is basically owned

by a wealthy and powerful elite. There are a lot more of us, but they out-gun us a million-to-one. It is a very daunting challenge.

How do you face up to the challenge of changing an entire paradigm that a society is structured on? We have a society that probably more than any society on earth is founded on principles like individual rights, and this really comes out in so-called private property issues. This is in contrast with other societies. We are probably the least civic-minded society on earth. And the paradigm our society favors, which it generously calls "individualism," is really one of greed.

Unless we change that, I don't see that there is going to be much progress. But how do you change something that is so deeply set in society? And so widely accepted? Well, one thing we can do is look at historical precedents of equal magnitude. We can take the challenges our society has faced in dealing with race relations and with gender relations. They are the two really big examples that come to mind. If you look at the legal apparatus or structure that pertained in the United States as late as 1860 and compare it to what exists in our legal system today, in terms of allocating rights according to skin color, it's been a complete flip-flop. Of course we have not eliminated racism, but as a society we did choose to reverse the weight of the problem. What I mean is that prior to the 1960s not only could Americans exercise racism in the absence of any serious social sanctions, there actually existed social support for it. That has changed.

So you can still be a racist in this society, but you're not going to get the kind of legal and social support that you did once. The same thing is true with sexism. You can look at law, and you can look at general social values. There have been dramatic changes to what pertained fifty years ago. Again, you can still be a sexist and you can still exercise sexual discrimination, but you do not have access to the kind of legal and social support that you used to. These are huge reversals.

We have not eliminated sexism, or racism, and we will probably never eliminate human greed or environmental destruction. But we can turn the tables. And we have models for how to do that. But one thing is pretty clear. It didn't come from the top down. It came from the ground up. And, there were prices to pay. Neither of these movements was free of violence, neither was free of considerable social upheavals, and if you look at for example, the abolition of slavery, there were serious economic consequences. The South economically as a region has never really recovered. Does that mean that the South is going to rise again, that we will re-institute slavery? I don't think so. In other words,

as a society we made a choice to make certain sacrifices on the part of some, so that the welfare of all could be better.

And I think that the environment is a really good analogy to that. It's about models. In other words, we have to be honest. And we cannot be like Al Gore during his presidential campaign and say we can have it both ways–sustainability and justice without giving up any of our comforts and privileges. We have to be honest, it's not going to help to lie to people and say you can have everything you want but still save the environment. It's not true. We're going to have to make sacrifices. That's a notion that is out there, that there are "soft" ways of making the adjustments that we need to make. I think that some changes are going to be more traumatic than others, but there's no getting around the fact that we are going to have to give up something. We can't keep taking and taking, and still ensure that the poor or future generations are going to have their fair share.

MODERATOR: Let's take the concept of this type of grassroots thing, and ask attorney Blackner, about the course that she has taken. That is, involvement through technology. We have heard our banquet speaker last night describe how suddenly and dramatically technology is making access, information, and participation occur. With the web site, you have discussed some 26,000 permits issued and some sixty denied, in the recent history of the Jacksonville District of the Army Corps of Engineers under the Clean Water Act.

BLACKNER: In the last twelve years, our web site reports it, at floridasos.com. The story that was published by the Daytona Beach News-Journal about two weeks ago, that when they did a ten-year review, giving statistics, less than half of one percent of the wetland permit applications were denied.

MODERATOR: Putting the permit approval volume in terms of what we were discussing, the public campaign, you seem to have a huge immobile object to move. And, you are attempting to do it through participation aided by new technology. To share information, to get people motivated. Are you getting that many hits on the site, are the number of objections to permits going up, is it a campaign that can bring the type of change you seek?...or is it better characterized as the best thing you can do?

BLACKNER: I have been so upset about the Corps, the self-regulators. So many environmentalists in Florida know about water management, yet they ask, what does the Corps do? The

Corps is in its offices, they don't do public hearings, you are not entitled to public hearings, you get thirty days to comment, how do you even get on the public notice list? How do you even know what they have jurisdiction over? What exactly are they doing? Why is the Army protecting the environment? All these things are going on for years, as a result of an historical accident.

George Washington needed the Corps in the Revolutionary War to build bridges and win the war, and they have been in charge of all these military engineering aspects of winning a war. Somehow when the Clean Water Act was amended, to provide for protection of the water of the United States not just for construction of water works, the Corps fell into this because they always had control over the rivers and harbors. So I started looking at the Corps and found them to be extremely user friendly. I started looking at some of their permits, and finding that they hardly ever denied permits, and I have the February 2001 Fish and Wildlife Service report criticizing the dredge and fill program in southwest Florida and saying, you don't follow your own rules! And I've been giving workshops for the last year and a half, in which I explain to people what the rules are, I give them the rules at my workshops, and I say the laws on the books really aren't that bad. But they are just not being enforced. And there is an institutional mind-set that is at play, in which the only real value that the Corps cares about as expressed in its permitting program is facilitating development.

And there are all these other values, that the Clean Water Act says are supposed to be looked at, including water control, wildlife, aesthetics (can you imagine the Clean Water Act actually says aesthetics are important!), water purification, all these wonderful tools that on paper are supposed to be protected as it all plays out in the day-to-day activity it just doesn't happen and the Corps fails to comply with its own rules and regulations. And here we are, we are told we are to follow the law, and the government does not follow its own law on a day-to-day basis. It is hypocrisy, yes, but it is worse than that. The Clean Water Act was not passed as some ideal of nirvana, but there is a real concern of protecting the public health. And all of this dredge-and-fill is going to affect the quality of life, your life, what about the future what about people 200 years from now? Do they count? I read a lot of permits and all I see the Corps say is, this permit will facilitate economic development, it will bring jobs, it will bring revenue into the community, and so on, and that is the only value I see reflected in the permit program. With respect to the water management district, they are supposed to go through this balancing test too, it is bogus! Let's be honest! At least the government should be honest enough to tell us that they really don't care about these other values, that what they care

about is development. At least we deserve honesty from our government, and we are not getting that.

MODERATOR: Dr. Peterson, you have looked at other cultures, and the magnitude of what we have to do as environmentalists. Perhaps you can describe where we go from here and what happens if we get an ethical dialogue going.

Is the consequence of the campaign that is going on by floridasos, if it comes to successful result, going to be some kind of a day when there is going to be a new dialogue? What do we do to get ready for that kind of a time, where they have had too many objections to these permits and their system is under enough of an assault that they come back to the table so to speak? When we get to that point, do we know what to do? Because we have been fighting them, we have been calling them bad names, or accurate names, but we are so polarized.

And do we have to alter our criteria further? We have been using wetlands as only one example. Some have suggested we could have a standard of sustainability as one concept for an inter-generational criteria.

PETERSON: There are a couple of things. When and if we got to the point where we can actually call "them" to account, one lesson from other cultures and specifically I am thinking of Central America, is that it is very different to be in opposition, challenging, fighting the noble fight, than actually to have some power. Your role is different. You have the same values but you have different means and resources at your disposal. You have different configuration of forces. It changes when the power and party changes. That is one thing we should keep in mind.

Although of course most of the focus is on getting there. And one thing that Ms. Blackner is saying about the law being on the books, but not being enforced, that echoes what was mentioned of the civil rights movement as a sort of analogy. It echoes what a lot of the rhetoric in the civil rights movement was. As a society we are saying we value liberty, equality for all, we say one person one vote, but that isn't being enforced. Although the civil rights movement had many streams, of course, it was able to say "We are not asking those in the United States to change your values, we are asking you to live up to them – which you are not doing." That is a less radical charge than saying "turn your values upside down," which other social movements had to do, and some aspects of the civil rights movement had to do. But at least there is a starting point in shared values.

As with civil rights, the environmental effort can always say, look, we have laws on the books, they may not do all that we'd like them to do, but if we could just get them enforced, we'd certainly be a lot better off than we are now. And those laws are on the books because Richard Nixon, among others, agreed to them. They represent widely shared values, as in the Clean Air Act and the Clean Water Act. That is not a radical, biocentric, deep ecology, or saying let's go (as Paul Shepard describes) back to the Pleistocene. These laws are not calling for that.

So if we already agreed that these are good things, that clean water is a good thing, that development has to take a back seat, in many cases, to issues of the common good, of public health, that the endangered species act is another law that has widespread social support, it's not radical. The Clean Water Act is not radical. You can say, "You guys already agreed to this, on paper at least. These laws are already on the books. We aren't asking you to do anything new. We are asking you to acknowledge that your actions don't provide a path to fulfill the values that you say you value."

I think that can be very fruitful approach. I don't want to sound like an undue optimist here. But there is an approach in ethics called communication and discourse ethics which has a lot of problems, but it can get people to think about values that we share. Maybe they have different approaches to getting to those values. Some of us have not been realistic about having it all, perhaps. We value jobs and we value wetlands, we value migratory birds, we value etcetera, but maybe we cannot really have it all.

And maybe that is a problem not just in terms of sustainability . . . we have to decide as a society what we are willing to sacrifice . . . to redefine what the good life means.

FOLTZ: I would just add a footnote of what was said a few minutes ago about the individualistic character of our society. Of course we all value our individual rights, and we value liberty and all of those other emotionally-charged terms that we associate with our culture. But I think that we are less willing to accept that these are concepts that have a flip side.

In other words, we are very quick to talk about rights. We are not so quick to talk about responsibilities. And I think that to talk about rights without responsibilities is pretty much meaningless. You have to deserve your rights. You have to earn them and you have to do it every single day. You do that by being responsible. This applies on the individual level, and it applies on the corporate level as well. It is a problem all the way around. Property owners often claim it is their right to do whatever they want on their

property, but such individuals are also members of a society and benefit from that membership in numerous ways.

And those benefits should carry responsibilities with them. In other words, it is not the end of discussion that you own the land deed. So where do we get these cultural values, how do we educate people to think differently? It is the same thing with corporations. Corporations have all kind of protections under the law, but relatively few responsibilities. For the past hundred years or so corporations have enjoyed the status of legal persons--which is something which I still find completely bizarre--except that they are only one-dimensional persons. They are persons in that they can enjoy the rights that persons can enjoy. But you cannot punish them in the way that you can punish persons. And the trend these days is to shield corporations even more from accountability for their acts. We need to be moving in the opposite direction; as a society, we need to get to the stage where it becomes impossible to talk about rights without talking about responsibilities in the same breath.

PETERSON: Just a kind of footnote on the corporations as persons concept. A conservative theologian, Michael Novak, several years ago wrote an article arguing that corporations are the Suffering Servant in today's world.

Q. Let's turn to our wetlands problem a little bit. Mrs. Blackner, mostly what people tell us about wetlands, is that the wetlands are mitigated. If someone confronts a permit applicant, the wetland still goes away. The applicant pays its dollars to save wetlands maybe in another county, and that is the result of the campaign and the emotional commitment and everything that has gone into the permit challenge.

BLACKNER: There are a number of reports, which you can click onto on the web site, which are by esteemed governmental bodies like the GAO, and the National Academy of Sciences, say that there are no real standards for evaluating whether mitigation is sufficient to compensate for what is being ruined. There is no follow-up enforcement, basically there is a gentlemen's agreement that oh, you're going to do this that and the other as your mitigation. The Corps certainly does not have the manpower to go out and see that people are doing what they are supposed to do. I think mitigation many times is just paper games to survive or pay for compliance. If mitigation were so great, Florida ought to be doing very well, but that's just not the case. It is sad that there is so much money pressure on these laws. Mitigation is sort of a feel-good mechanism

for everybody involved. And so much discretion is afforded to agencies to determine what the mitigation is going to be. Even though, the Clean Water Act says, and we have it on our web site, the presumption is that if you have a jurisdictional wetland, and you want to do something on that wetland that is "non-water-dependent".

In other words you don't have to be in the wetland to do that particular thing. Is a house water-dependent? No, you don't have to be in a wetland to build a house. Is a road water-dependent? No, you don't have to be in a wetland to build a road. Is rice farming wetland-dependent? Well, yes, I guess it is. But if you have a non-water-dependent activity, the presumption is that there are other places other than wetlands to do your dirty deed. And one of the things that was reported, the Corps never invokes the fundamental rule, that if your have a non-water-dependent activity the presumption is there are other places for your to do your business, and you shouldn't be getting your permit in the first place. And this is what I have been trying to teach people. That on paper the Clean Water Act could be an extraordinary tool. But the people in power really don't want the Clean Water Act to succeed. So we have pretty laws sitting in books, on the shelves and they aren't playing out on a day-to-day basis to protect the public interest, as I construe the public interest. And, the wolves are assigned to guard the hen house.

That's another one I'd like to see. I'd like the Corps stripped of its authority; it makes me sick to see the Corps put in charge of Everglades restoration, when they are the ones who were the source of the problems. They are engineers, they want to "fix" everything. And, our county and local governments are much the same.

So what do we do? They need to be stripped of their zoning authority. I heard of a situation in California, where the public became so sick of the upzoning of everything, that you know what they did? They amended their county charter, to strip the county commission of their upzoning authority, now if anyone wants to upzone, it has to be put to vote. That should be the environmental movement's focus, because local government is at every level it is so controlled by developers. How do we give the power back to the people? That's what I want to do. Amend the Florida Constitution, restricting upzoning to voter-approved changes.

I would like the Corps to get five to ten comments on permits. Over time, the Corps might have to change its ways. (Audience discussion.)

(Audience remarks: Some stated they have pressured the Army Corps of Engineers successfully at times. Reflections on the need

to change the system after thirty years of experiencing the problems, systems are always designed against those who want to bring change. There is a desire on the part of the public to go to work, come home, and be with family and friends. But developers at work concentrate on their needs in the permit system - "their life is development." The Corps of Engineers is one of the most effective organizations to have doing anything. Because the one thing they know is, "follow your orders." They are being told to act the way they are. That is our problem. The law firm advertisement slogan is, "You do have rights, but justice is not automatic." This is like environmental law enforcement. The government acts, and demonizing the opposition is not the point. Government personnel take the path of least resistance. With only one player in the game, it is easy for them. And the government is there to represent the government, not to represent the citizens. They are an arbiter. Government staff will tell you, you can say things the government staff cannot, due to their role as a neutral arbiter. It is an adversarial public and legal system. To get a favorable decision, it has to be easier, with some kind of basis to rule for the public interest. And, the citizen at the bargaining table or with a public interest attorney in court is likely to be the only one there not being paid. Citizens with day jobs need public interest attorneys with some level of funding. The other side is more just players, than demons. Others say the government has to be expected to resist the one-sided pressure. A comment from an Orlando resident reflected that she sees a million issues all at the same time, so that she could not even go to every county commission meeting, write letters to the editor daily, and even with all the support of organized groups. More expectation on public officials as representatives is needed, and accountability of the staffs. Another said in presenting an issue on a permit for citizens at a negotiation, the motives of the objecting citizens were questioned, and the validity of representation of a group of its members was rejected. Public hearing requests were rejected out of hand.)

BLACKNER: I once experimented, sending comments on some permits, and testing for the reaction. After several months, I got a call from an attorney with the Corps to request I call them before I comment. The reason was, "It's really slowing it down for the Corps to issue the permit, and the morale at the Corps is very low anyway. We are terribly overworked because as you know, a permit applicant pays $100 to process an application." That is regardless of the size of the project, and only if they issue the permit. If they do not, they do not have to pay. The Corps trusts the information provided by the applicant or the consultant. So the applicant is in

charge of all the information that the Corps relies on. The Corps rarely goes out and does an on-site inspection to assess jurisdiction. It is likely the massive amount of wetlands and massive amount of development in Florida were not being thought of when the Clean Water Act was being adopted. If the rules were followed, it would be expensive and time consuming. I have talked to people at the Corps. Well, they say, Water Management says it is O.K., and the local government does not have an objection, but what people do not understand is that the rules governing the Corps are quite different than the rules and obligations of the others.

(Audience: There are technical ethics, but legislators and the rest know the strong public view requires them to enact good laws. But it is like laws in Florida are not meant to be enforced. The problem is the ethic is that the laws are not to be enforced here.)

MODERATOR: Do we have to have the stepped up litigation and objection, to get the other side to the table?

(Audience: Maybe a public relations campaign to educate the public of the lack of enforcement.)

BLACKNER: Why should the public be paying for a permitting program?

(Audience: People are jaded, they think government works.)

PETERSON: There are subsidies for so many things. Whether it is cars, or beef, or you name it, the real cost is not measured. Here full cost accounting is a very valuable tool.

FOLTZ: And there have been some steps in this direction, for instance Germany, in modifying products and their packaging in ways that take their ultimate disposal into account. The existing paradigm has been that a company manufacturing a product only deals with that product through a brief window of that product's existence. The point is to expand that involvement. Public subsidies and other forms of corporate welfare are also good targets, but the problem is that these are deliberately hidden from the public and a lot of digging is required to bring them to light. Then the problem is industry's typical response, that the product will be priced out of the market. But we need to recognize that maybe there is a good reason why that product should be priced out of the market. Then products like wind energy and solar power will be seen to be economically preferable to petroleum. We will cease

growing our fruit in deserts like central California. People who talk about supporting the free market often do not want free markets at all; they want all kinds of government interference and control, but they want the kind that which benefits them. If we believe in a free market, let's really free it. And let the market tell us that certain activities are not economically viable.

PETERSON: Socialism for the rich, capitalism for the rest of us.

(Audience Q.: When we deal with case-by-case, we are bound to oversimplify the issue and the sides. We deal in a world where communication and media are strong forces. The complex layering that is present is often overlooked, is there a method to apply in public settings so it will not occur that way?)

FOLTZ: When Neil Rudenstine was president at Harvard he used to introduce the law school graduates as "those responsible for the wise restraints that make us free." It helps I think if we acknowledge that we already accept a lot of constraints, which is what laws are, on our freedom. We talked about false dichotomies, but they are not dichotomies. Being pro-environment does not mean being anti-people. It is the opposite. To be pro-people means to be pro-environment, because people cannot live outside of an environment and they cannot thrive in an unhealthy one. We have to look at where these notions come from, the idea that the interests of people are separate from the interests of the environment. Part of this comes from Enlightenment thinking, some 300 years ago, that humans exist somehow in some vacuum in isolation from all other phenomena in the universe. If you think about it, and state it, it is obviously false. Yet very often, we operate as if that is the case. Once we identify the false dichotomies, like being pro-environment is anti-human, I do not see where the ethical dilemma is. What is the ethical dilemma about survival?

PETERSON: I use a book in a social ethics class by Anthony Weston, called *A Practical Companion to Ethics*, which is helpful about dichotomies. Weston talks about the debate over abortion, which is of course more polarized than even environmental debates, people are either "pro-choice" or "pro-life." That's it: if you are one, you cannot be the other. But even people who are pro-life, in the vast majority, do want abortions permitted in certain cases where rape, incest, or the woman's life is in danger, so they are not absolutist. And most pro-choice people also have limits where they would be opposed to abortion in certain cases. So in a debate where things are polarized, discussion has brought out agreement on

certain education and policies and training and social welfare. There have been some dialogues and in Wisconsin, there were policy changes. That is a good but isolated example. Causing people to focus on what they agree on is a first step that we could aim for.

BLACKNER: That was my experience. I saw myself as middle of the road, but I was labeled a radical. Environmental concerns are like police, or good schools. It is all bread-and-butter middle-class stuff. Why are we painted into this corner, of being special interests? What of future generation rights?

(Audience: Environmental justice, the debate over the siting and planning of activities that have impacts especially on low income and minority communities, can cover the same issues that are covered by direct environmental approaches. Whether wetlands, or wildlife, or others, the issue of environmental justice and proper environmental decisions intersect.)

PETERSON: Reduction of consumption is crucial also. To protect forests, less demand for paper needs to follow. Stopping logging is not a solution where demand for the product continues, and logging is just shifted to Indonesia, or Mexico, or Brazil.

FOLTZ: I would add that, especially in the Western states, industries like logging, mining and grazing enjoy enormous taxpayer subsidies through bargain rates on public lands. Part of the answer to giving people something else to do, can be rephrased as giving them something socially beneficial rather than socially harmful to do. For instance, the defense industry pays people to build bombs that kill people; is that something we want to do? We do not want people to be out of work, but if the price is paying them to do harmful or destructive things, is that appropriate? Whereas if we were to eliminate the public subsidies on grazing, mining and so on, millions of dollars would become available which could then be used instead for socially constructive purposes, retraining and creating industries and livelihoods for displaced workers, and so on. These kinds of social welfare programs would not require raising peoples' taxes, but rather not squandering them on the wrong kind of subsidies.

(AUDIENCE: If you do not have extremes, you do not have a middle. If they can pull me toward their side, it makes their job easier. I am one of the unpaid citizens, in the room where everyone else is paid to be there. We have to challenge even when we know we will not win. But a fight is really necessary. Reconciling our

differences, the conference theme, is really lovely, but in practice, if you do not have the extreme position and go against insurmountable obstacles, you never get to the middle. So I prepare for battles that create the middle that is probable.)

BLACKNER: I make a living with my husband, and I'm lucky he indulges in this, because I do not get paid for the environmental work. I do it because of the Florida I knew when I grew up, and I feel a personal responsibility. I do not expect a panacea or to change the world, but at least I have some peace of mind. I may be labeled, but I cannot be like people that talk the talk but do not walk the walk. But as far as the different points of interest, I do not see any reconciliation for a long time.

AUDIENCE: What are some of the arguments for different values that Dr. Peterson referred to earlier, that can be offered by people wishing to protect the environment?

PETERSON: You could argue to preserve, say, wetlands because it is important for human health. Or because there is an aesthetic appreciation. Or because of rights. There are rights apart from any human benefit. . . . Christopher Stone's discussion in *Do Trees have Standing?* raises some of that.

FOLTZ: I would add that the intrinsic value argument is ethically speaking the highest level of argument. But in terms of actually making it operative, is perhaps the most difficult. Still, there are analogies to other major paradigm shifts. Our ancestors in many cultures did not acknowledge non-white humans as being human in the same way as they considered themselves to be humans, so the idea of extending rights, or, in legal terms, "considerability," to non-white humans was a major hurdle. Then the same hurdle had to be gone over with non-male humans, to extend moral considerability to women. That non-white or non-male humans might have interests of their own, independent of whether they are useful to white male humans, was once as revolutionary a notion as the idea of non-human interests is today. Agreeing that some group other than your own has valid interests which are independent of your own group's interests is a pretty tough moral argument to make, but it is a very high moral argument.

APPENDIX: PANELIST BIOGRAPHIES

LESLEY BLACKNER is an attorney in the firm of Blackner, Stone & Associates. She is a graduate of the University of Florida School of Law and was a law clerk for the Fifth District Court of Appeal for several years before entering private practice. For the past few years she has practiced law in Palm Beach with her husband, Richard Stone. She has litigated several environmental citizen suits on behalf of environmentalists. Her particular interest is in educating citizens as to the nuts and bolts of how environmental laws should work and started a website, floridasos.com, to teach people how to demand enforcement of the Clean Water Act. She is also a founder of a new organization, Floridians for Environmental Accountability & Reform, devoted to the novel proposition that environmental laws that have been on the books for years are not enforced in the State of Florida.

PROFESSOR RICHARD C. FOLTZ, Ph.D. is Assistant Professor at the University of Florida in the Department of Religion and with the College of Natural Resources and Environment, Department of History, and Asian Studies program. His teaching includes courses on religion and nature and on the Muslim world. He holds a Ph.D. in History and Middle Eastern Studies from Harvard University, an M.A. in Applied Linguistics from the University of Utah, and a B.A. in Middle East Studies/Persian from the University of Utah. He has traveled to fifty-five countries on five continents. He has studied and written scholarly works on the intersection of environmental positions and religious views of many cultures. Among his many written contributions is a forthcoming book he has edited, *Worldviews, Religion, and the Environment: A Global Anthology*.

PROFESSOR ANNA L. PETERSON, Ph.D. is Associate Professor in the Department of Religion and affiliate of the Center for Latin American Studies and the College of Natural Resources and the Environment at the University of Florida in Gainesville. In 2001, she was named a University of Florida Research Foundation Professor. She received a Ph.D. in Ethics and Society from the University of Chicago Divinity School in 1991. She teaches and writes on social and environmental ethics and on religion and politics in Latin America. With her colleagues Manuel Vasquez and Philip Williams, she co-edited Christianity, Social Change, and Globalization in the Americas (2001). Her present research focuses on the role of religious ideas and structures in the creation and maintenance of sustainable communities in Latin America and the

U.S. Peterson chairs the Sierra Club National Sustainable Consumption Committee and serves on the club's Sustainable Planet Strategy Team. She has written numerous journal articles as well as the books Martyrdom and the Politics of Religion: Progressive Catholicism in El Salvador's Civil War (1997) and Being Human: Ethics, Environment, and Our Place in the World (2001).

2002 RECOMMENDED WEB SITES FOR NATIONAL PARKS AND FLORIDA PARKS

JOHN T. CARDILLO*

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"I knew long ago and rediscovered that the best way to attract attention, help and conversation is to be lost."

John Steinbeck, *Travels with Charley*

I. INTRODUCTION

"The Bear is going to get you," is a famous British saying in golf. Essentially, it means that on the fourth day of a four day tournament, the "bear" of heat, exhaustion and nerves will attack a golfer's game. Two summers ago, I witnessed a different interpretation of the saying. Camping with my family in Yosemite National Park, the park rangers had given us strict instructions regarding the hunger and ferocity of the park bears. Not even toothpaste could be kept in our cabin as the bears could detect its odor. Everything had to be stored away in a bear proof locker. Before going to sleep, we locked away our provisions, except for an undetected bag of potato chips, which was detected by a hungry, ferocious visitor at three o'clock in the morning. The bear almost got us.

Bears included, summer vacation stories have always been a favorite topic in my family. With the summer approaching, we inevitably reminisce about the trips we have taken in the past. For example, there was the time we drove from Naples, Florida to Seaside Park, New Jersey by way of Toronto, Canada, and an unsuspecting Quaker Village in Kentucky. There was the time my cousin and I painted a barn for enough money to go camping along the Maine Coast, until the money ran out in Canada at the Bay of Fundee Park. There was even a time when my father drove the six of us from Tijuana, Mexico to Vancouver, Canada in less than 16

* J.D. The Florida State University College of Law, (expected May 2003). The author would like to thank his family for the countless travel memories, as well as Sylvia Barnhart and Donna Catron, for listening to the countless travel memories.

days, hitting every national park and seaside vista along the way. Is there a prettier drive in the world than Big Sur?

Thanks to my parents, our summer vacations have proven to be as informative as they have been entertaining. In our travels, my father has never hesitated (notwithstanding fruitless protests from the back seat) to travel more than a few hours out of the way to make it to a national park, or an important point of interest. While at ten years old I might not have been interested in a field where a "last stand" took place, I now realize what my father's goal was. He wanted his kids to have exposure to as many of our country's treasures as possible. Not only were our horizons broadened, we now have the opportunity to take our children to the places our parents so tirelessly extracted from the wrinkled AAA maps. Our parents successfully built a treasure chest of memories.

Following is a review of web sites for some of the national and Florida parks we have visited, as well as other recommendations. By no means is this list meant to be definitive. A cursory inspection of the Web will reveal just how many state and national parks we have at our disposal. Whether this summer, or any season, I invite you to take John Steinbeck's advice and "get lost" in a park.

II. FEDERAL PARKS

Generally, *http://www.nps.gov* is a helpful research site regarding United States National Parks. Its home page has links for everything from a general description of each park, including links to help with travel accommodations, to scientific information concerning the parks.

Acadia National Park
Location: Bar Harbor, ME
URL: *http://www.nps.gov/acad/index.htm* and *http://www.acadia.national-park.com/*

While many of the Park's activities seem to be concentrated around Bar Harbor, a campsite on either peninsula can be a perfect location. Whether you are looking for large, frigid Atlantic waves or sunny camping trails, Acadia has something for everyone. Make sure to take the 27-mile Park Loop Road.

Black Canyon of the Gunnison National Park
Location: near Montrose, CO
URL: *http://www.nps.gov/blca/* and *http://www.americansouthwest.net*

The sheer walls of the Black Canyon, carved out by the Gunnison River, bear the appearance of the dramatic Dolomites of Cortina d'Ampezzo, Italy. While the Canyon is narrow (only 40 feet apart in some places), it's depth of 2900 feet provides sufficient space for exploration.

Bryce Canyon National Park
Location: Bryce Canyon, UT
URL: *http://www.nps.gov/brca/index.htm* and *http://www.bryce.canyon.national-park.com/*

The Canyon's colorful limestone, sandstone, and mudstone make a perfect backdrop for the park's natural horseshoe-shaped amphitheaters.

Cape Cod National Seashore
Location: Wellfleet, MA
URL: *http://www.nps.gov/caco/index.htm*

Having attended college in the Boston area, I was constantly reminded of the magic of Cape Cod. Instead of taking advantage of its booming summer industry (lobster pound after lobster pound), I visited the Cape on a cold, windy, November day. The time of year is irrelevant. The Cape's lore, including massive sand dunes, and charming cottages, is a special place any time of year.

Cape Hatteras National Seashore
Location: near Manteo, NC
URL: *http://www.nps.gov/caha/index.htm*

With its rich history of shipwrecks, fishing, surfing, and other activities, the "Graveyard of the Atlantic," on the Outer Banks, has plenty to offer. Unfortunately, the legendary Cape Hatteras Lighthouse is closed for the remainder of 2002.

Although not a national park, Kitty Hawk, NC is a perfect compliment to Cape Hatteras. A resort area, Kitty Hawk is famous for its Outer Bank setting and quaint clapboard cottages. Kitty Hawk can be researched at *http://www.kitty-hawk.com/*.

Carlsbad Caverns National Park
Location: near Carlsbad, NM
URL: *http://nps.gov/cave/index.htm* and *http://carlsbad.caverns.national-park.com/*

As one of the world's largest underground chambers, Carlsbad Caverns boasts the nation's deepest limestone cave (1567 feet) and several other magnificent formations.

Cumberland Gap National Historical Park
Location: Midllesboro, KY
URL: *http://nps.gov/cuga/index.htm* and *http://www.cumberlandgaptn.com/*

The borders of Tennessee, Kentucky and Virginia converge in this break of the Appalachian Mountains, which is touted as the "first doorway to the west."

Denali National Park and Reserve
Location: near Denali Park, AK
URL: *http://nps.gov/dena/index.htm* and *http://denali.national-park.com/*

With North America's highest mountain, Mount Mickenly, 20,320 feet, countless other mountains, glaciers and a complete sub-arctic eco-system, this six million-acre-park is host to grizzly bears, wolves, and moose; not to mention park visitors who come for wildlife viewing, mountaineering, and backpacking.

Dinosaur National Monument
Location: near Vernal, UT & Dinosaur, CO
URL: *http://www.nps.gov/dino/index.htm* and *http://www.american.southwest.net*

This park is home to the critical habitat for the endangered Peregrine Falcon, Bald Eagle, Colorado Pikeminnow, Razor Back Sucker, and a large deposit of fossil dinosaur bones.

Glen Canyon National Recreation Area
Location: Glen Canyon National Recreation Area, AZ, UT
URL: *http://www.nps.gov/glca/index.htm*

Water lovers will enjoy the opportunities that this park offers for boating, fishing, swimming, as well as backcountry hiking and four-wheel drive trips.

Golden Gate National Recreation Area
Location: San Francisco, CA
URL: *http://www.nps.gov/goga/index.htm* and *http://www.llbean.com/parksearch/parks/html/2359gd.htm*

Located minutes away from hip, modern San Francisco, the Golden Gate National Recreation Area provides the perfect juxtaposition between urban and rural. The park includes five campgrounds, the land north and south of the Golden Gate Bridge, Muir Woods, and Alcatraz Island. The park offers pickinicking, fishing, tours, and scenic walks of one of the most naturally beautiful landscapes in North America.

Grand Canyon National Park
Location: Grand Canyon, AZ
URL: *http://www.nps.gov/grca/index.htm* and *http://www.thecanyon.com*

Natural amphitheaters, aerial tours, hiking, donkey rides, white water rafting, and nice accommodations are only a few of the numerous attractions that bring people flocking to this natural wonder. A suggestion: one of the Canyon's most magical sights is the sunrise over its walls. Getting up at five o'clock in the morning is a good way to beat the crowds, and the heat.

Grand Teton National Park
Location: Moose, WY
URL: *http://www.nps.gov/gte/index.htm* and *http://www.grand.teton.national-park.com/*

Located in the vicinity of Jackson Hole, WY, at 13,000 plus feet, the "youngest" section of the Rocky Mountains, is as scenic, as it is charming.

Hawaii Volcanoes National Park
Location: near Hilo, HI
URL: *http://www.nps.gov/havo/index.htm* and *http://www.hawaii.volcanoes.national-park.com/*

Over half of this park is designated as wilderness. The unusual hiking and camping opportunities allow visitors an excellent opportunity to view complex and unique ecosystems. From sea level, to the summit of earth's most massive volcano, Mauna Loa, 13,677 feet, as well as earth's most active volcano, Kilauea, visitors can expect an adventurous stay.

Lewis and Clark National Historic Trail
Location: IA, ID, IL, KS, MO, MT, ND, NE, OR, SD, WA
URL: *http://www.nps.gov/lecl/index.htm*

Named after Captain Merrivwether Lewis and Captain William Clark, the Lewis and Clark National Historic Trail is located in eleven states: Illinois, Missouri, Kansas, Iowa, Nebraska, South Dakota, North Dakota, Montana, Idaho, Oregon, and Washington. It begins near Wood River, Illinois, and finishes, with a grand finale, some 3700 miles later, in the Washington, at the Pacific Ocean.

Mammouth Cave National Park
Location: Mammouth Cave, KY
URL: *http://www.nps.gov/maca/index.htm* and *http://www.mammouth.cave.national-park.com/*

At 336 plus miles, Mammouth Cave National Park is the longest recorded cave system in the world.

Mount Rushmore National Memorial
Location: Keystone, SD
URL: *http://www.nps.gov/moru/index.htm*

Mount Rushmore's newly opened Presidential Trail allows spectators views of animals and plants, native to Black Hills, SD.

Muir Woods National Monument
Location: near Mill Valley, CA
URL: *http://www.nps.gov/muwo/index.htm* and *http://www.visitmuirwoods.com/*

Named after the legendary naturalist, John Muir, this ancient redwood forest is located only a few miles from San Francisco. The park offers hiking, interpretive displays, and, as the website mentions, "solitude." With the backdrop of the Pacific Ocean, this promises to be a very reflective place. John Muir declared: "This is the best tree-lovers monument that could possibly be found in all the forest of the world."

Natural Bridge of Virginia
Location: Natural Bridge, VA
URL: *http://www.naturalbridgeva.com/*

Since I can remember, my father has displayed a black and white picture of his family in front of the Natural Bridge in his office. The natural phenomenon of a solid rock arc inspired Thomas Jefferson to write, "It is impossible for the emotions arising from the sublime to be felt beyond what they are here; so beautiful an arch, so elevated so light, and springing as it were up to heaven, the rapture of the spectator is really indescribable!"

Pecos National Historic Park
Location: Pecos, NM
URL: *http://www.nps.gov/peco/index.htm*

The park, which preserves 12,000 years of history, includes the ancient pueblo of Pecos, two Spanish Colonial Missions, and Santa Fe Trail sites.

Petrified Forest National Park
Location: Petrified Forest National Park, AZ
URL: *http://www.nps.gov/perfo/index.htm* and *http://www.petrified.forest.national-park.com/*

The park, located in northeast Arizona, features on of the world's largest and most colorful concentrations of petrified wood, as well as the Painted Desert.

Point Reyes National Seashore
Location: Point Reyes, CA
URL: *http://www.nps.gov/pore/index.htm* and *http://www.pointreyes.net/*

The intense energy of the Pacific and the historic Point Reyes Lighthouse (not to mention the area's giant oysters), make this coastal area, north of San Francisco, unforgettable.

Redwood National and State Parks
Location: Del Norte & Humboldt counties, CA
URL: *http://www.nps.gov/redw/index/htm*

Similar to Muir Woods, the Redwood parks provide visitors an opportunity to view trees, up to 2000 years old, and 300 feet tall.

Rocky Mountain National Park
Location: near Estes Park and Grand Lake CO
URL: *http://www.nps.gov/romo/index.htm* and *http://www.rocky.mountain.national-park.com/*

The image of gigantic, snow-capped mountains, for as far as the eye can see, will be permanently etched in your memory. Not far from Denver, this park is an absolute treasure to the National Park system.

Saint-Gaudens National Historic Site
Location: Cornish, NH
URL: *http://www.nps.gov/saga/index.htm* and *http://www.sgnhs.org/saga.html*

Located in the rolling hills of New Hampshire, Saint-Gaudens features the home, gardens, and studios of Augsutus Saint-Gaudens, an Nineteenth Century American sculptor. From the end of June, through the end of August, concerts are performed from the sculptor's house, every sunny Sunday afternoon at two.

Saratoga National Historic Park
Location: Stillwater, NY
URL: *http://www.nps.gov/sara/index.htm* and *http://www.audubon.org/iba/saratoga/.html*

Located in eastern Saratoga County, along the western bank of the Hudson River, this historical site commemorates the Revolutionary Army's halting of the British Army in 1777. Another popular attraction, near Stillwater, NY, which also involves animals, is the legendary Saratoga Race Track.

Sequoia & King's Canyon National Park
Location: Near Three Rivers, CA
URL: *http://www.nps.gov/seki/index.htm* and *http://www.sequoia.national-park.com*

Visitors to Sequoia and King's Canyon National Park will get a wide variety of sites: everything from mountains and deep canyons, to trees that are older than our country.

Yellowstone National Park
Location: Yellowstone National Park, ID, MT, WY
URL: *http://www.nps.gov/yell/index.htm* and *http://www.yellowstone-natl-park.com*

Yellowstone National Park allows visitors the opportunity to see bears, wolves, bison, elk, mountainous terrain, clean water and air, thousands of hot springs, and, of course, the famous geyser, Old Faithful

Yosemite National Park
Location: Sierra Nevada, CA
URL: *http://www.nps.gov/yose/index.htm and, http://www.yosemite.com* and *http://www.yosemite.org*

As a high school student, I used to keep an Ansel Adams print of Half Dome, and other Yosemite sites, in my bedroom. Two summers ago, I was fortunate enough to see the sites in person. It is difficult to comment on the sheer beauty of this park, and all of its natural wonders. Waterfalls, rock formations, vistas and meadows provide visitors with days of activities. Needless to say, almost every site in the Park could be a famous print.

III. FLORIDA PARKS

For a general overview of Florida State Parks, visit: *http://www.floridaparks.com*, *http://www.florida-outdoors.com/parks.htm*, *http://www.thingstodo.com/states/FL/nationalparks/*, and *http://www.dep.state.fl.us/parks/index.asp*. Each site provides a list of Florida's parks, activities and links to help with travel plans.

Apalachicola National Forest
Location: near Gadsden County, FL
URL: *http://ww.southernregion.fs.fed.us/florida/forests/apalachicola.htm*

Located in the Florida Panhandle, visitors can camp, hike, bike, or take a canoe trip down one of the Forest's rivers. Those who take a canoe trip into the Gulf of Mexico are rewarded with the opportunity to eat at some of the best oyster bars in the country.

Big Cypress National Preserve
Location: Ochopee, FL
URL: *http://www.nps.gov/bicy/index.htm*

Vast strands of Cypress trees cover over 700,000 acres of preserved land. Big Cypress Preserve, set aside because of its importance as a watershed to Everglades National Park, was founded in 1974.

Biscayne National Park
Location: Homestead, FL
URL: *http://www.nps.gov/index.htm*

The Keys' notorious turquoise water, exotic fish and wildlife rich environment make this sun-drenched South Florida park a memorable vacation destination. John Pennekamp Coral Reef State Park is located nearby, and can be researched at *http://www.pennekamppark.com/home.htm*.

Cape Canaveral National Seashore
Location: near Titusville and New Smyrna Beach, FL
URL: *http://www.nps.gov/cana/index.htm*

Located on Florida's Atlantic Coast, the Cape Canaveral Seashore presents its visitors with numerous opportunities for fishing, surfing and horseback riding. The Seashore also boasts over 1045 species of plants and 310 species of birds.

Castillo De San Marcos National Monument
Location: St. Augustine, FL
URL: *http://www.nps/gov/casa/index.htm*

Completed in 1695, the Castillo De San Marcos National Monument is the first permanent European settlement in the continental United States. On the shore of Mantazas Bay, the park consists of the fortress and surrounding grounds.

Dry Tortugas National Park
Location: near Key West, FL
URL: *http://www.nps.gov/drto/index/htm*

A 70 mile boat ride away from Key West, this cluster of seven islands, composed of coral reefs and sand, is surrounded by crystal clear Gulf water. Fort Jefferson, on Garden Key, was built in the 1800's for its strategic location in the Florida Straits.

Everglades National Park
Location: near Miami, Homestead and Naples, FL
URL: *http://www.nps.gov/ever/index/htm*

Spanning most of South Florida, Everglades National Park is the only subtropical preserve in North America. Visitors can expect to see several types of birds, such as the Great Blue Heron, coexisting alligators and crocodiles, wave upon wave of sawgrass and large cypress swamps. Visitors to the southwest part of the Park are encouraged to search out Shark Valley at *http://www.nps.gov/ever/visit/tramroad.htm*.

Looe Key National Marine Sanctuary
Location: near Big Pine Key, FL
URL: *http://thefloridakeys.com/dive/divesites/looe.htm*

Looe Key is a natural reef located five miles south of Big Pine Key. Activities such as skin diving, snorkeling and fishing make Looe Key one of the most spectacular sanctuaries in the country.

Naples Conservancy Nature Center
Location: Naples, FL
URL: *http://www.naplesdowntown.com/attrnatc.htm*

Located on the Gordon River, visitors can either walk around the center's grounds, or take boat excursions into the surrounding mangroves. A branch of the Naples Conservancy is located on the way to Marco Island, FL, which gives visitors a more in depth look at the "door to the Ten Thousand Islands." Sandfly Island, located near Everglades City, FL, will provide visitors with an even more in depth look at the Ten Thousand Islands. A Sandfly excursion can be researched at *http://www.florida-outdoors.com/8canoe-gc.htm* and *http://www.everglades.national-park.com/boat.htm*.

National Audubon Society's Corkscrew Swamp
Location: near Naples, FL
URL: *http://naples.com/corkscrew/* and *http://www.florida-everglades.com*

Located near Naples, Florida, Corkscrew Swamp contains the world's largest remaining old-growth Bald Cypress forest.

Ocala National Forest
Location: Orlando, FL
URL: *http://www.r8webcom/flroida/forests/ocala.htm* and *http://www.gorp.com/dow/southern/ocal.htm*

Located near Orlando, Ocala National Forest receives more visitors than any other National Forest in Florida. Hiking, biking and camping are among the recreational activities.

Osceola National Forest
Location: near Lake City, FL
URL: *http://www.southernregion.fs.fed.us/florida/forests/osceola.htm*

Visitors can participate in hunting, beach activities and camping on Hog Pen Landing.

St. George Island State Park
Location: St. George Island, FL
URL: *http://www.floridaparks.com/stgeorgeislandstatepark.htm*

St. George Island presents its visitors with a relaxing beach environment, and an opportunity to eat superb seafood. The famous Chili Cookoff takes place on the island each March.

St. Joseph Peninsula State Park
Location: near Port St. Joe, FL
URL: *http://www.geocities.com/stjoestatepark/page2.htm*

Surrounded by St. Joseph's Bay to the east, and the Gulf of Mexico to the west, the park is home to migratory birds, nine miles of white sand beaches, striking sand dune structures, and lucky tourists. This park was named Best Beach in America by Stephen Leatherman, a.k.a. "Dr. Beach," for 2002. *See* www.drbeach.org.

St. Vincent Island
Location: St. Vincent Island, FL
URL: *http://www.floridaparks.com/brokeatoesoutdoor.htm* and *http://www.stvincentislandecotours.com/*

When touring the Florida Panhandle don't miss this gem of an island. A National Wildlife Preserve directly west of St. George Island, it is only accessible by boat and hosts a variety of wildlife such as a herd of Indonesian Sambar Deer, the endangered Red Wolf, as well as a multitude of birds and other species. Completely protected from development, this barrier island is home to one of the most beautiful and secluded beaches in the world which is rarely visited by tourists.

RECENT DEVELOPMENTS

KARA J. BERLIN*

Table of Contents

I. INTRODUCTION

This section highlights recent developments in federal and state environmental and land use case law. In addition to the sources cited in this section, the reader is encouraged to consult the website of the Environmental and Land Use Section of the Florida Bar, <http://www.eluls.org>, the website of the Florida Department of Environmental Protection at <http://www.dep.state.fl.us>, and the U.S. Environmental Protection Agency at <http://www.epa.gov>. Other useful sources the reader may wish to consult include FindLaw Legal News at <http://www.findlaw.com>, the Florida State Courts: Opinions, Court Rules, and Other Court Documents at <http://www.flcourts.org>, and the Supreme Court of the United States website at <http://www.supremecourtus.gov>.

II. FEDERAL CASES

New York v. FERC, 122 S. Ct. 1012 (2002)

The United States Supreme Court combined the cases of New York and Enron Power Marketing, Inc. (Enron) against the Federal Energy Regulatory Commission (FERC) to determine the FERC's jurisdiction over the transmission of electricity.[1] The Court answered two questions in these cases: (1) if a public utility unbundles the cost of transmission from the cost of electrical energy in billing retail customers, may the FERC require the utility to transmit competitors' electricity over its lines on the same terms as those applied to utilities transmitting their own energy, and (2) is the FERC bound to impose the same requirements on utilities continuing to offer bundled sales.[2] The FERC addressed these questions in 1996 in Order No. 888, answering yes to the first and

* J.D., The Florida State University College of Law (April 2002).

1. *See* New York v. Fed. Energy Reg. Comm'n, 122 S. Ct. 1012, 1016 (2002).
2. *Id*.

no to the second.[3] The Supreme Court, agreeing with the FERC's statutory interpretation, affirmed the court of appeals.[4]

In 1935, when the Federal Power Act (FPA) became law, most electricity was sold by separate, local monopolies subject to state or local regulation.[5] At this time electricity sales were bundled, which meant that consumers paid a consolidated charge including costs for electric energy and the cost of delivery.[6] With the enactment of the FPA, Congress authorized federal regulation of electricity for areas that were beyond the state's powers and extended federal coverage to some areas that had been state regulated.[7] The FPA charged the Federal Power Commission (FPC), the predecessor of the FERC, with the power to "provide effective federal regulation of the expanding business of transmitting and selling electric power in interstate commerce."[8] Congress has recognized that the FPC's jurisdiction includes both transmission and wholesale distribution of electric energy in interstate commerce.[9]

Due to technological advances, the local networks of the past are mostly gone. Electricity is now generated more efficiently and delivered over three major networks, also called "grids."[10] Most of the electricity that enters the grids today is immediately part of a pool of energy moving through the states.[11] This results in the ability of power companies to transmit electricity over long distances at a low cost.[12] This in turn results in the ability of utilities to operate more efficiently by transmitting electricity between plants and regions.[13] Under this system, the public utilities retain ownership of the transmission lines used by competitors to deliver electricity to both wholesale and retail customers.[14] This retained control gives the utilities the power to refuse to deliver competitors' energy, or to apply less favorable terms and conditions to the competitors.[15]

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3. *Id*.
4. *Id*.
5. *Id*. at 1016-17.
6. *Id*. at 1017.
7. *Id*. (discussing the previous Supreme Court decision of Public Util. Comm'n of R.I. v. Attleboro Steam & Elec. Co., 273 U.S. 83 (1927).
8. *Id*. (citing Gulf States Util. Co. v. FPC, 411 U.S. 747, 758 (1973)).
9. *Id*. (citing 16 U.S.C. § 824(b) (2000)).
10. *Id*. at 1017-18.
11. *Id*. at 1018. Once the electricity enters the grid it becomes part of interstate commerce.
12. *Id*.
13. *Id*. (citing Order No. 888).
14. *Id*.
15. *Id*.

Congress has responded to the changes in the electricity market with two laws: the Public Utility Regulatory Policies Act of 1978 (PURPA) and the Energy Policy Act of 1992 (EPAct).[16] PURPA's purpose is the promotion of development of new generating facilities as well as conservation of fossil fuels.[17] To this end PURPA required the FERC to promulgate rules that required utilities to purchase electricity from "qualifying cogeneration and small power production facilities."[18] The EPAct authorized the FERC to require individual utilities to provide unaffiliated wholesale generators with transmission services.[19] The FERC then initiated a rulemaking proceeding that led to the order under review by the Court.[20] The rule proposed by the FERC in these proceedings would:

> [R]equire that public utilities owning and/or controlling facilities used for the transmission of electric energy in interstate commerce have on file tariffs providing for nondiscriminatory open-access transmission services.[21]

The purpose of this rule was to encourage lower rates through a structured transition to competitive bulk markets.[22]

Following the receipt of comments on the proposed rule, the FERC issued Order No. 888.[23] The FERC found utilities were discriminating by providing wholesalers either inferior access, or no access at all, to their networks.[24] The FERC remedy included three relevant portions: (1) the FERC ordered "functional unbundling"[25] of wholesale generation and transmission services; (2) The FERC imposed an open access requirement on unbundled retail transmissions that went through interstate commerce; and (3) the

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16. *Id*. at 1018-19.
17. *Id*. at 1019.
18. *Id*. (citing Fed. Energy Reg. Comm'n v. Mississippi, 456 U.S. 742, 751 (1982)).
19. *Id*. This authority was exercised by the FERC on a case-by-case basis. Under this authority, the FERC ordered a utility to "wheel" power for a wholesale competitor twelve times. The FERC concluded that these individual proceedings were too costly and time consuming and as such, did not provide an adequate remedy.
20. *Id*.
21. *Id*. (citing Notice of Proposed Rulemaking, 60 Fed. Reg. 17662 (1995)).
22. *Id*.
23. *Id*.
24. *Id*. (citing Order No. 888).
25. Defined as requiring each utility to separate the rates charged for generation, transmission, and ancillary services, as well as to take its own transmission under a single tariff, applicable to itself and others. *Id*. at 1020.

FERC rejected the proposal of applying the open access requirement to bundled retail transmissions.[26]

Following the issuance of Order No. 888, the FERC received many petitions for rehearing and clarification.[27] The FERC responded to the challenges by saying that the open access requirements were issued to remedy the undue discrimination that had been found and as such was within their authority.[28] Further, the FERC responded to concerns regarding its failure to assert jurisdiction over bundled services when it had asserted jurisdiction over unbundled services. The FERC explained it did not feel bundled services required regulation and that to do so would raise jurisdictional issues.[29] Many of these petitions were consolidated and heard by the Court of Appeals for the District of Columbia.[30] The court of appeals upheld most of the Order's provisions, and specifically upheld the jurisdictional rulings raised for review to the Supreme Court.[31] The Supreme Court granted review on petitions filed by New York and Enron, questioning the FERC's assertion of jurisdiction over unbundled and bundled retail transmissions.[32]

New York raised the first question on appeal, arguing that the FERC exceeded its jurisdiction by including unbundled retail transmissions within the open access requirements because retail transactions are subject to state regulation.[33] New York asserted that the FERC/state jurisdictional line fell between wholesale and retail transmissions.[34] The Court rejected this argument, agreeing with the court of appeals that the FPA supported FERC jurisdiction.[35] The Court emphasized the language of section 210(b) of the FPA, which states that the FERC's jurisdiction includes "the transmission of electric energy in interstate commerce" and "the sale of electric energy at wholesale in interstate commerce." The Court concluded that since the statute did not limit transmission jurisdiction to wholesale, and did limit sale jurisdiction to wholesale, that the transmission jurisdiction included retail.[36]

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26. *Id*. at 1019-20.
27. *Id*. at 1021.
28. *Id*.
29. *Id*.
30. Transmission Access Policy Study Group v. Fed. Energy Reg. Comm'n, 225 F.3d 667 (D.C. Cir. 2000).
31. *Id*. at 681.
32. 122 S. Ct. at 1022. As the petitioners did not raise for review the issue of wholesale transmissions, the Court does not address such. The Court only answers the questions raised as to the FERC's jurisdiction over retail transmissions. *Id*.
33. *Id*.
34. *Id*.
35. *Id*.
36. *Id*.

New York's arguments in support of its position of the line between wholesale and retail markets were three-fold. First, New York argued the court of appeals erred in its standard of review by not considering the presumption against federal preemption of state law.[37] Second, that the statutory language and legislative history show an intent to safeguard the preexisting state regulations of retail electric delivery.[38] Third, allowing FERC jurisdiction over retail transmissions would not be sound energy policy.[39]

The Court rejected New York's presumption against preemption argument, stating that the issue was that of defining the proper scope of federal power, not if a federal authority has displaced a state authority.[40] The latter, the Court said, raises the notion of the presumption against preemption.[41] The former, which is at issue in this case, simply requires that Congress' intent to supercede the powers of the state be clearly manifested.[42] Through statutory interpretation, the Court determined that Congress authorized the FERC's jurisdiction over transmitting and selling as separate activities.[43] Taking it one step further, the Court found that because Congress specifically confined the FERC's jurisdiction over sale to wholesale, yet did not limit the transmission market accordingly, the FERC's exercise of this authority is valid.[44] As to the legislative history argument, the Court rejects New York's contention that the legislative history was meant to preserve state regulation; at the time of the FPA's enactment all electricity was delivered in bundled packages.[45] Thus, the Court reasoned, there could not be state regulation of something that did not exist.[46] Further, the federal jurisdiction is only applicable to unbundled transmission, and the state retains jurisdiction over sales of the energy.[47] Finally, as to the policy argument advanced by New York, the Court directs New York to make such arguments to the Commission or to Congress, as they are not properly addressed to the Court.[48]

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37. *Id*. at 1023.
38. *Id*.
39. *Id*.
40. *Id*.
41. *Id*.
42. *Id*.
43. *Id*. at 1024.
44. *Id*.
45. *See id*. at 1025.
46. *Id*.
47. *Id*. at 1026. The Court also notes that the FERC did not assert jurisdiction over bundled retail transmissions, leaving New York in complete control over even the transmission aspect of bundled sales. *Id*.
48. *See id*. at 1027.

The Court next addressed Enron's petition, which attacked the FERC order from the opposite direction. Enron argued that the FPA granted the FERC the authority to apply open-access to bundled retail transmissions and that since FERC had found undue discrimination, they were obliged to utilize this authority.[49] FERC explained its reasoning for not extending open-access to bundled transmissions, saying such relief was not necessary and that it raised jurisdictional issues that did not need resolution at the time.[50] The Court found these to be valid reasons to support the decision not to regulate bundled transmissions.[51]

AGG Enter., Inc. v. Washington County,
Nos. 00-35449, 00-35511, 00-35509, 00-35510,
2002 WL 378127 (9th Cir. Mar. 12, 2002)

The Ninth Circuit Court of Appeals reversed the district court, dissolving a permanent injunction preventing Washington County and the City of Beaverton from enforcing trash-hauling regulations against AGG Enterprises (AGG).[52] AGG is a private collection company, which collects from non-residential customers mixed solid waste (MSW) containing both recyclables and non-recyclables.[53] AGG claimed the MSW are "property" preempted from state regulation by the Federal Aviation Administration Act of 1994 (FAAAA).[54] Washington County asserted that the MSW is garbage, not property, and therefore local regulation is not preempted.[55]

AGG picks up waste materials[56] from commercial, industrial, and construction sites.[57] The waste is referred to as "mixed solid waste" because the customers do not sort the garbage from the recyclables prior to pickup. After pickup, AGG delivers the MSW to East County Recycling, which separates and recycles the recyclables and delivers the garbage to a landfill.[58] This service offers AGG customers a cost-effective mechanism for disposing of their waste without having to sort garbage from recyclables, yet

49. *Id*.
50. *Id*. (citing Order No. 888).
51. *Id*.
52. AGG Enter., Inc. v. Washington County, Nos. 00-35449, 00-35511, 00-35509, 00-35510, 2002 WL 378127, at *1 (9th Cir. Mar. 12, 2002).
53. *Id*.
54. *Id*.
55. *Id*.
56. Materials collected include: brick, glass, tile, concrete, wood, cardboard, plastic, and metal. *Id*.
57. *Id*.
58. *Id*.

still allowing the customers to recycle.[59] This service is not offered by the government-licensed trash-haulers, who do not separate MSW or take it to a facility to be separated.[60] The exact amount of recyclables recovered from MSW is unknown, but estimates range from 50%-60%, to as high as 80%-90%.[61]

Washington County uses exclusive franchises to regulate trash collection, issuing licenses that grant exclusive authority to collect waste in a particular area.[62] These licenses apply to the collection of both residential and commercial collection, but do not regulate source sorted recyclables.[63] Because AGG does not hold one of these exclusive licenses granted by the County, it was cited for the unauthorized collection of waste .[64] AGG then applied for a license, which the County refused to grant.[65] AGG then filed a petition for injunctive relief with the United States District Court.[66]

The district court granted AGG's request for injunction, finding that AGG was a motor carrier transporting property and Washington County's licensing scheme was therefore preempted by the FAAAA.[67] On a de novo review the court of appeals held that the FAAAA did not preempt local regulation of the collection of MSW and dissolved the injunction.[68]

In analyzing AGG's preemption argument the court started with the "presumption that Congress does not intend to supplant state law."[69] Historic state powers are not superceded by federal law unless that is the clear and manifest intent of Congress.[70] According to the court:

> One could hardly imagine an area of regulation that has been considered to be more intrinsically local in nature than collection of garbage and refuse, upon which may rest the health, safety, and aesthetic well-being of the community.[71]

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59. *Id*.
60. *Id*.
61. *Id*.
62. *Id*. at *2.
63. *Id*.
64. *Id*.
65. *See id*.
66. *Id*.
67. *Id*.
68. *Id*. at *5.
69. *Id*. at *2 (citing New York State Conference of Blue Cross & Blue Shield Plans v. Travelers Ins. Co., 514 U.S. 645, 654 (1995)).
70. *Id*.; *Blue Cross* at 655.
71. *AGG*, 2002 WL 378127, at *3.

Because of the history of state regulation, the court found it necessary to take a cautionary analysis to determine if Congress preempted local regulation.[72] Looking at the language of the FAAAA, and considering the absence of a definition of the term "property," the court found it necessary to address the legislative history of the FAAAA to answer the preemption question.[73] The court determined that the legislative history evidenced an intent by Congress not to preempt state or local regulation of solid waste collectors.[74] In so holding, the court rejected AGG's argument that Interstate Commerce Commission case law considers MSW to be "property" and not "garbage" subject to local regulation.[75]

Chevron U.S.A. Inc. v. Mobil Producing Texas,
No. 01-1016, 2002 WL 276781
(Fed. Cir. Feb. 27, 2002)

Chevron U.S.A.. (Chevron) brought a restitution suit against Mobil Oil Producing Texas and Mobil Oil Corporation (Mobil) to recover payments made to the Department of Energy (DOE) for stripper well overcharges attributable to Mobil's working interest in a property owned by Chevron.[76] The Court of Appeals for the Federal Circuit disagreed with the District Court for the Western District of Texas and held that a consent order entered into between Mobil and DOE in 1979 did not settle Mobil's liability and that Chevron is entitled restitution for the payments made based on overcharges attributed to Chevron's working interest.[77]

Under the Emergency Petroleum Allocation Act of 1973 (EPAA), the United States instituted price controls for crude oil. The EPAA contained an exemption for stripper wells that allowed for crude oil to be sold at free market prices when it was produced at a property with an average daily production not exceeding ten barrels per well over the previous year.[78] Following a challenge to a Federal Energy Administration (FEA)[79] ruling prohibiting the counting of injection wells in the calculation of averages, the district court held the

72. *See id*.
73. *Id*.
74. *Id*. at *4.
75. *Id*.
76. Chevron U.S.A., Inc. v. Mobil Producing Texas, No. 01-1016, 2002 WL 276781 (Fed. Cir. Feb. 27, 2002). Publication pages references were not available for this case at the time of the writing of this article and therefore no pinpoint cites will be given.
77. *Id*.
78. *Id*.
79. The FEA is the predecessor to DOE.

ruling was void and prohibited its enforcement.[80] Pending review by the Temporary Emergency Court of Appeals, the district court required the oil companies to deposit the difference between the free market price and the regulated price into an escrow account.[81] The Temporary Emergency Court of Appeals upheld the enforceability of the FEA ruling.[82]

In 1979, while the appeal was pending, Mobil and DOE entered into a consent order resolving the crude oil sales.[83] Then, in 1987, DOE sued Chevron for additional recovery.[84] Chevron asserted that a portion of this claim included liability of Chevron's predecessor, Gulf, as operator of Mobil's working interest in a property at East Waddell Ranch.[85] From September 1977 through October 1978, stripper well oil from Mobil's working interest in the ranch was sold to Gulf at free market prices.[86] This was contrary to the FEA ruling.[87] These charges were not covered by escrow deposits.[88]

Chevron settled DOE's claims in 1992, and seeks reimbursement from Mobil for the portion due to improper characterization of stripper well sales from Mobil's working interest at the ranch.[89] The district court held that Mobil's consent order with DOE resolved its compliance related to crude oil sales and therefore Chevron was not entitled to recovery.[90] The appeals court disagreed.

Chevron argued on appeal that the consent order did not include settlement of Mobil's stripper well liability as at the time of the consent order there was no stripper well liability.[91] Mobil argued that Chevron should have raised this claim against the DOE as a defense against the inclusion of such charges in the assessment against Chevron and that the failure to raise it with the DOE constituted waiver.[92] Chevron appealed the district court ruling, pointing to a lack of supporting evidence and an inconsistency in the basis of the ruling.[93]

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80. *Id*. (citing Energy Reserves Group, Inc. v. Fed. Energy Admin., 447 F. Supp. 1135 (D. Kan. 1978)).
81. *Id*.
82. *Id*. (citing *In re* Dep't of Energy Stripper Well Exemption Litig., 690 F.2d 1375 (Temp. Emer. Ct. App. 1982)).
83. *Id*.
84. *Id*.
85. *Id*.
86. *Id*.
87. *Id*.
88. *Id*.
89. *Id*.
90. *Id*.
91. *Id*.
92. *Id*.
93. *Id*. Chevron asserts that since stripper liability was not even imposed at the time of

In response to Mobil's claim that Chevron raise the prior payment as a defense to its assessment, the appeals court deemed it "unlikely that the parties [to the consent order] intended to settle Mobil's entire stripper well liability as working interest owner. . . ."[94] The court further concluded that the working interest violation was not severable from other overcharges arising out of inclusion of injection wells.[95] The court found that liability was not established until the 1982 Temporary Emergency Appeals Court ruled, and the consent order did not settle such potential liability.[96]

As to the contribution question, because Chevron presented undisputed evidence that it had paid Mobil's overcharges for the East Waddell Ranch and because Mobil's only evidence was the consent order, the court stated that a balancing of the equities would fall in favor of Chevron.[97] The court held that liability remained with Mobil, despite DOE's collection from Chevron.[98] Therefore, the court ordered Mobil to reimburse Chevron for the amounts paid to DOE for the overcharges attributable to Mobil's working interest.[99]

III. FLORIDA CASES

Panda Energy Int'l v. Jacobs, No. SC01-284, 2002 WL 243076 (Fla. Feb. 21, 2002)

In *Panda Energy*, the Florida Supreme Court approved a determination of need for a 530-megawatt electrical power plant to be built in Polk County.[100] The Public Service Commission (PSC) granted the determination of need for the construction of the power plant, known as "Hines 2," in response to a proposal by Florida Power Corporation (FPC).[101] Panda Energy International (Panda) challenged the PSC's granting of the determination of need and raised three issues for review.[102] First, was the limiting of Panda's discovery and the denial of Panda's motion for a continuance, after

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the order it could not have been meant to include settlement of claims not yet in existence.

94. *Id*.
95. *Id*.
96. *Id*.
97. *Id*.
98. *Id*.
99. *Id*.
100. *See* Panda Energy Int'l v. Jacobs, No. SC01-284, 2002 WL 243076, at *1, *7 (Fla. Feb. 21, 2002).
101. *Id*.
102. *Id*.

being granted intervenor status, an abuse of PSC's discretion?[103] Second, whether the standard used by PSC in determining need for the Hines 2 plant was correct under *Tampa Electric Co. v. Garcia*.[104] Third, whether the PSC's finding that FPC had complied with the *Florida Administrative Code* in conducting the bidding process was supported by competent substantial evidence.[105]

Prior to seeking approval for the construction of Hines 2, FPC did an internal analysis of its needs and determined that the Hines 2 plant would provide the most cost-effective solution.[106] Following this determination, FPC invited independent power producers to offer proposals of alternatives to Hines 2.[107] Only two bidders submitted bids; one of them was Panda.[108] FPC rejected Panda's proposal as "inferior" to its own self-build proposal, concluding that the Panda proposal would cost FPC customers an additional $60 million.[109]

Following the solicitation of outside bids and the conclusion that self-build was the most cost effective, FPC filed a petition with the PSC for a determination of need and for approval to build Hines 2.[110] The PCS granted FPC's determination of need, finding "Florida Power Corporation has a need for additional capacity to maintain the reliability and integrity of its system," and that the Hines 2 was "the most cost-effective alternative over the 25 years during which FPC's ratepayers will be obligated for the costs of the unit."[111] The PSC also found that FPC complied with the bid rules.[112]

In response to Panda's claim that PSC denied it due process as an intervenor by both limiting its opportunity for discovery and denying its request for continuance, the court found that the PSC did not abuse its discretion.[113] Following the FPC's filing of the petition for determination of need the PSC appointed a prehearing officer; the prehearing officer issued a scheduling order that set the final hearing date, set a deadline for intervenors to file prefiled testimony, set the deadline for the PSC to file prefiled testimony and the subsequent deadline for FPC to file rebuttal testimony, and

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103. *Id*.
104. *Id*. *See* Tampa Elec. Co. v. Garcia, 767 So. 2d 428 (Fla. 2000).
105. *Panda Energy*, 2002 WL 243076, at *1.
106. *Id*.
107. *Id*.
108. *Id*.
109. *Id*.
110. *Id*. (citing such requirement as present in FLA. STAT. § 403.519 (2000)).
111. *Id*.
112. *Id*.
113. *Id*. at *3 (reviews of limitations on discovery and continuance denials are on an abuse of discretion standard).

set the cutoff date for discovery.[114] The deadline for filing testimony passed and both FPC and PSC filed their prehearing statements without anyone filing a motion to intervene.[115] Panda sought leave to intervene the day after the prehearing conference and filed the motion to intervene two weeks prior to the final hearing.[116] PSC granted Panda's leave to intervene and extended the discovery date in order to allow Panda to take requested depositions of FPC consultants.[117] Relying on the *Florida Administrative Code* and the allowances made to Panda upon intervening, the court determined the PSC did not limit Panda's opportunity to engage in discovery.[118] The court further found that Panda's request for a continuance was not made for "good cause" or within the applicable time limits as required by the *Florida Administrative Code* and therefore, the PSC did not abuse its discretion in denying such request.[119]

The court rejected Panda's assertion that the PSC used an incorrect standard in conducting its needs analysis for Hines 2.[120] Panda asserted that *Tampa Electric*[121] changed the PSC's requirements for granting a determination of need to a Florida regulated utility.[122] The court rejected this argument, clarifying *Tampa Electric*'s application to non-Florida retail utilities.[123] *Tampa Electric* addressed the issue of the PSC having jurisdiction to grant a determination of need to a non-regulated out-of-state wholesale power company.[124] Therefore, the court stated, *Tampa Electric* did not alter the need determination standards applicable to Florida utilities.[125] Because the standards were not changed by *Tampa Electric*, the court held that the PSC properly applied the relevant criteria.[126]

Panda's final challenge reviewed by the court was that the PSC's finding that FPC complied with the *Florida Administrative Code* rules for bidding processes was not supported by competent

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114. *Id*. at *2.
115. *Id*.
116. *Id*.
117. *Id*.
118. *Id*. at *3 (citing FLA. ADMIN. CODE R. 25-22.039, which says intervenors "take the case as they find it"). Despite the "take it as you find it" rule, the PSC granted Panda extensions and ordered document production by FPC on Panda's behalf in order to facilitate the discovery process. *Id*.
119. *Id*. at *3 (citing FLA. ADMIN. CODE R. 28-106.210) .
120. *See id*. at *4.
121. *See* Tampa Elec. Co. v. Garcia, 767 So. 2d 428 (Fla. 2000).
122. *Panda Energy*, 2002 WL 243076, at *5.
123. *Id*.
124. *Id*. (citing *Tampa Electric*, 767 So. 2d at 436).
125. *Id*. at *5.
126. *Id*.

substantial evidence.[127] Panda asserts the FCP's request for proposals "was flawed in various ways."[128] Among these were Panda's assertion that the request for proposals did not contain information on the weight to be accorded the price and non-price attributes, did not specifically state the type of production costing models being used, and that FPC did not develop a short list for further negotiation after the initial screening.[129] On review of FPC's process the court found that the failure to assign specific weights to individual factors was done to stimulate creativity in the proposals and that the failure to specify the production costing model was not fatal as the models used were industry standards.[130] The court further found Panda's contention of the required short list to be without merit.[131] As FPC only received two bids, both of which were given full and fair consideration, a short list for negotiation was not necessary.[132] Based on these factors, the court held that competent substantial evidence supported the PSC's determination that FPC's request for proposals was proper.[133]

Bradfordville Phipps Ltd. P'ship v. Leon County, 804 So. 2d 464 (Fla. 1st DCA 2001)

In *Bradfordville*, the First District Court of Appeal affirmed the circuit court's holding that the imposition of a temporary injunction prohibiting the county from issuing certain development permits did not amount to a temporary regulatory taking.[134] Bradfordville Phipps Limited Partnership (Partnership) appealed to the DCA, challenging the Second Judicial Circuit Court's denial of its motion for summary judgment and the granting of Leon County's (County) summary judgment motion.[135] The First DCA found that the Partnership's claim was not ripe for review and that the

127. *Id*. *See also* FLA. ADMIN. CODE. R. 25-22.082 (setting forth what must be included in a request for proposals).
128. *Panda Energy*, 2002 WL 243076, at *6.
129. *Id*.
130. *Id*. at *6-*7.
131. *Id*. at *7.
132. *See id*.
133. *Id*.
134. *See* Bradfordville Phipps Ltd. P'ship v. Leon County, 804 So. 2d 464 (Fla. 1st DCA 2001).
135. *Id*. at 465.

Partnership had not met the requirements of the *Lucas* test[136] to prove a temporary regulatory taking had occurred.[137]

Following the circuit court's imposition of an order, in another proceeding, prohibiting the County from issuing certain development permits within the Bradfordville Study Area, the Partnership filed an inverse condemnation action against the County.[138] The Partnership alleged that the County's actions resulted in an inability of the Partnership to continue with the development and use of its property which deprived the Partnership of "all reasonable economic use of its property."[139] The Partnership further alleged that it submitted a completed application for an Environmental Permit relating to the development of its property, which was a prerequisite to the issuance of any building permits, and that the County rejected this application because of the injunction.[140]

In an effort to comply with the court's injunction, the County adopted an Interim Development Ordinance, restricting the issuance of development permits for the Bradfordville Study Area for a seven-month period.[141] Following this, the County adopted an ordinance implementing the provisions of the Comprehensive Plan; this ordinance constituted the requisite action of compliance with the injunction and the circuit court dissolved the injunction.[142]

The trial court found that despite the Partnership's financial burden caused by the delay, that under the undisputed facts of the case there was no taking.[143] Further, the trial judge determined the Partnership's claim did not meet the ripeness test as the Partnership had not made any effort to intervene or otherwise challenge the injunction entered in the other suit.[144] Specifically the court found that the Partnership had actual or constructive knowledge of the likelihood of land use restrictions and as such, the court's action and the County's ordinance were not reasonably

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136. *See* Lucas v. South Carolina Coastal Council, 505 U.S. 1003 (1992). The test for a taking is "when the owner of real property has been called upon to sacrifice *all* economically beneficial uses in the name of the common good, that is, to leave his property economically idle, he has suffered a taking." *Id*. at 1019.

137. *Bradfordville*, 804 So. 2d at 468.

138. *Id*. In an unrelated proceeding, the circuit court previously imposed upon the County an injunction forbidding issuance of future building permits in the Bradfordville Study Area until the County came into complaince with the Land Use Element of the Leon County Comprehensive Plan. *Id.* at 465-66.

139. *Id*. at 466.

140. *Id*..

141. *Id*.

142. *Id*. at 467.

143. *Id*.

144. *Id*.

unexpected.[145] Furthermore, the restriction was only temporary.[146] Therefore, the financial burden caused by the delay in permitting was not compensable.[147] The Partnership appealed, raising for review the trial court's ripeness analysis and takings law determination.[148]

On review, the DCA questioned the need for a ripeness analysis at all, given the nature of the temporary regulatory taking claim.[149] However, the court concluded that to the extent a ripeness analysis was appropriate, the trial court was correct in determining the Partnership's claim was not ripe as the Partnership never tested the injunction or obtained a final determination regarding the extent of the regulation on the use of its property.[150] The court also found that the trial court was correct in its determination that the Partnership had not met the burden of the *Lucas* test to establish a regulatory taking.[151]

In holding that the Partnership had not met the required elements for a temporary regulatory taking, the DCA relied on a Ninth Circuit decision, *Tahoe-Sierra Preservation Council, Inc. v. Tahoe Regional Planning Agency*.[152] In *Tahoe-Sierra*, the court held that a temporary development moratorium was not a categorical taking under *Lucas* because it did not deprive the landowner of "all" of the value or use of the property.[153] The DCA stated their agreement with the Ninth Circuit that "a temporary land use regulation could rarely, if ever, completely deprive the owner of all beneficial use."[154] The DCA concluded that the injunction was temporary, designed only to suspend certain development until the County came into compliance with the Comprehensive Plan.[155] The court went on to say that while a moratorium may restrict or delay the use of property, it cannot be said that a moratorium which is temporary from its inception destroys the economic value of property.[156] In conclusion, the DCA stated that a truly temporary

145. *Id*. at 468.
146. *Id*.
147. *Id*.
148. *Id*.
149. *Id*.
150. *Id*.
151. *Id*.
152. *See* Tahoe-Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency, 216 F.3d 764 (9th Cir. 2000).
153. *Id*. at 782.
154. *Bradfordville*, 804 So. 2d at 471.
155. *Id*.
156. *Id*.

injunction is more similar to a permitting delay than a compensable regulatory taking.[157]

Bd. of Tr. of the Internal Improvement Trust Fund v. Day Cruise Ass'n, Inc., 798 So. 2d 847 (Fla. 1st DCA 2001)

In *Day Cruise*, the First District Court of Appeal addressed a motion for clarification, rehearing, certification, or rehearing en banc (Motion) from the Board of Trustees of the Internal Improvement Trust Fund (Trustees).[158] The Motion stemmed from the court's decision in *Board of Trustees of the Internal Improvement Trust Fund v. Day Cruise Ass'n, Inc.*[159] (Day Cruise 1), confirming the invalidation of a proposed Trustees rule.

The Trustees proposed a rule forbidding the use of sovereignty submerged lands for mooring or anchoring cruise ships whose main purpose was to take passengers out to gamble at sea.[160] In *Day Cruise 1*, the DCA reviewed a decision of the Administrative Law Judge that the proposed rule was beyond the Trustees' authority.[161] At issue in the DCA's decision was the prohibition's basis not on the use the vessels make of the sovereignty lands, but on the use of the vessels once they have left the shore.[162] The court found that the authority granted to the Trustees by the Legislature was not compatible with adoption of the proposed rule.[163] The *Florida Statutes* grant the Trustees the authority to adopt rules governing uses of sovereignty submerged lands by vessels, limited to "regulations for anchoring, mooring, or otherwise attaching to the bottom. . . . The regulations must not interfere with commerce or the transitory operation of vessels through navigable water ."[164] The court found that the Trustees were not authorized to promulgate a rule prohibiting the use of submerged lands which have no physical or environmental impact on the sovereignty submerged lands.[165]

In the Motion, the Trustees assert that the decision in *Day Cruise 1* is in conflict with controlling precedents.[166] The DCA

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157. *Id*.
158. Bd. of Tr. of the Internal Improvement Trust Fund v. Day Cruise Ass'n, Inc., 798 So. 2d 847 (Fla. 1st DCA 2001).
159. Bd. of Tr. of the Internal Improvement Trust Fund v. Day Cruise Ass'n, Inc., 794 So. 2d 696 (Fla. 1st DCA 2001).
160. *Id*. at 697.
161. *Id*.
162. *Id*. at 697-98.
163. *Id*. at 702.
164. *Id*. (citing FLA. STAT. § 253.03(7)(b) (1999)).
165. *Id*.
166. *Day Cruise*, 798 So. 2d at 847. The Trustees cite Southwest Florida Water

rejected this argument, stating that *Day Cruise 1* is "fully consonant" with previous decisions.[167] The court denied the Trustees' Motion except to certify the following question as one of great public importance:

> Is proposed rule 18-21.004(1)(i) an invalid exercise of delegated authority within the meaning of section 120.52(8)(b) or (c), Florida Statutes (1999)?[168]

Management District v. Save the Manatee Club, Inc., 773 So. 2d 594 (Fla. 1st DCA 1999) and Mariner Properties Development, Inc. v. Board of Trustees of the Internal Improvement Trust Fund, 743 So. 2d 1121 (Fla. 1st DCA 1999), as being in conflict with the court's decision in *Day Cruise 1*.

167. *Day Cruise*, 798 So. 2d at 847.

168. *Id*. at 848.

BOOK REVIEW

ROMÁN ORTEGA-COWAN*

WELL GROUNDED: USING LOCAL LAND USE AUTHORITY TO ACHIEVE SMART GROWTH. By John R. Nolon, *Charles A. Frueauff Professor of Law and Director of the Land Use Law Center at Pace University School of Law*. Environmental Law Institute: 2001.

INTRODUCTION

> Zoning . . . represents the unique American contribution to the solution of disputes over competing demands for the use of private land. When there are conflicting interests, it is patently necessary for someone to determine which of these are valid....[1]

Clearly we need *someone* to determine the validity of competing interests for the use of land; the real question is who the *right* someone is for such a decision.[2] A growing distaste with sprawl[3] has led to increased public interest in the effective management of land development in response to population growth,[4] but the collision between resulting federal, state, and local controls has led to more heat than light on the subject.

John R. Nolon clearly states that such confusion is beyond the scope of this endeavor;[5] his focus is rather on an education strategy in response to the poor results of a top-down regime's attempts to impose land use authority upon local governments with their own

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* J.D., The Florida State University College of Law (expected May 2003); B.A. Boston College, 2000.

1. JOHN R. NOLON, WELL GROUNDED: USING LOCAL LAND USE AUTHORITY TO ACHIEVE SMART GROWTH 443 (2001) (quoting RICHARD F. BABCOCK, THE ZONING GAME: MUNICIPAL PRACTICES AND POLICIES, at xvi (1966)).

2. The author suggests the *right* someone is local government, at least until a "higher level of government can [effectively unify] the chaotic palette of local land use decisions." *Id.* at 6.

3. *See* Ann Brown et al., *Sprawl: The Dark Side of the American Dream*, *available at* http://www.sierraclub.org/sprawl/report98 ("Sprawl is low-density development beyond the edge of service and employment, which separates where people live from where they shop, work, recreate, and educate — thus requiring cars to move between zones.") (on file with author).

4. The author states the reactive term "growth management" has given way to the proactive term "smart growth," although both share the goal of preventing sprawl. NOLON, *supra* note 1, at 2.

5. *Id.* at 6.

agendas.[6] The author sums up the point of his work well by quoting the man whose words have guided its creation: "I know of no safe depository of the ultimate power of society but the people themselves, and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion by education."[7]

DESCRIPTION

The author begins by introducing the reader to the basic elements of local land use law and practice. A thorough overview of the terms, procedures, and roles of citizens, the judiciary, and local decision-making boards provides the reader with a foundation upon which to base an understanding of how smart growth may be successfully achieved at the local level.

Chapter Two builds on this foundation by explaining the basic requirements of smart growth. It presents an extensive description of zoning methods, then comprehensively compares and contrasts them with smart growth methods. Chapter Three affords an overview of the relationship between comprehensive plans and zoning. The author presents a detailed portrait of these concepts first through a series of diagnostic checklists and then with an evaluation of relevant New York land use law.

Chapter Four gives an extensive description of local practice. It begins with the basic implementation procedure of local authorities and proceeds to describe the variance and permit, as well as subdivision and site plan proposal, evaluation processes. The chapter closes with an extensive discussion of uses that often create conflict among neighboring parties, as well as the enforcement of use regulations.

Chapter Five begins the discussion of environmental impact. Specifically, it leads the reader through New York's State Environmental Quality Review Act (SEQRA)[8], which has had an enormous impact on New York land use decisions since its adoption in the 1970s.[9] Chapter Six extends this discussion to techniques such as creative zoning and planned developments available to local governments to balance development and conservation efforts.

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6. *Id.* (suggesting it may be better to acknowledge the resiliency of local power and to work with it rather than try to supersede it; if local officials are not educated in land use matters, the solution is to provide them with such education).

7. *Id.* (quoting Thomas Jefferson to William C. Jarvis (1820), *available at* http://etext.lib.virginia.edu/jefferson/quotations/jeff0350.htm) (on file with author).

8. N.Y. ENVTL. CONSERV. LAW §§ 8.0101-8.0117 (McKinney 1997).

9. NOLON, *supra* note 1, at 183 (requiring an environmental impact evaluation as part of almost all decision levels).

Chapter Seven uses examples of New York statutes enabling intermunicipal coordination to describe the authority local New York governments have to bring about better overall development results. Chapter Eight closes out the environmental discussion through description of the body of New York environmental law local governments use to protect their natural resources.

Chapter Nine explains the points of tension where federal, state, and local land use authority overlap. It provides a thorough description of the statutory and constitutional limits on land use that local governments deal with and how such governments have been able to maintain control in the face of such overarching interests. Finally, Chapter Ten discusses the effect land use regulations may have on private property rights and how citizens may challenge the regulations to protect such rights.

ANALYSIS

The author presents a large body of interesting and important information in an easily accessible format. Although the focus is primarily on New York land use law, the book serves a dual purpose: New York citizens and officials may use it as a practical guide and students throughout the country may use it to learn of a valuable strategy that may (and arguably should) be employed by all fifty states.[10]

10. It is worth noting, however, that this book may not be a popular choice among professors for a primary text in a land use course taught outside of the Empire State.

ABSTRACTS

VOLUME 17

David L. Callies, *Fred Bosselman and the Taking Issue*, 17 J. LAND USE & ENVTL. L. 3 (2001).

As the first of four tribute pieces to Professor Bosselman, this article is an overview of three works by Professor Fred Bosselman which had a significant impact on the takings issue: *The Quiet Revolution in Land Use Control*, *The Taking Issue*, and A Model Land Development Code. All three had a tremendous influence on land use law as current practitioners know it. The author offers unique insight from the position of one who worked with Professor Bosselman on the first two projects as well as helping Professor Bosselman with the implementation of the Model Code in Florida.

Daniel R. Mandelker, *Fred Bosselman's Legacy to Land Use Reform*, 17 J. LAND USE & ENVTL. L. 11 (2001).

This tribute describes two state-level control techniques that Professor Bosselman pioneered: the regulation of Areas of Critical State Concern and the control of Developments of Regional Impact. The critical area technique has become accepted by state and local governments in land use regulation. The DRI has also gained acceptance, notably in Florida.

Craig A. Peterson, *Twenty-five Years of Taming Tourism*, 17 J. LAND USE & ENVTL. L. 23 (2001).

This tribute discusses Professor Bosselman's contributions to understanding, conceptualizing and managing tourism growth. The author includes a discussion of Professor Bosselman's works: *In the Wake of the Tourist: Managing Special Places in Eight Countries*; and *Managing Tourism Growth: Issues and Applications.* As a co-author of the second work, the author offers a unique insight into the mind of one of the leaders in land use and environmental law.

A. Dan Tarlock, *Fred Bosselman as Participant-Observer Lawyer: The Case of Habitat Conservation Planning*, 17 J. LAND USE & ENVTL. L. 43 (2001).

In the final tribute piece, the author, a colleague and close friend of Professor Bosselman's at Chicago-Kent, shares his insight

into the world of Professor Bosselman as the "Participant-Observer." Specifically the author discusses Professor Bosselman's contributions to Habitat Conservation Plans and their implementation in California.

John T. Cardillo, *Recent Developments in Land Use & Environmental Law*, 17 J. LAND USE & ENVTL. L. 183 (2001).

This section highlights recent developments in federal and state environmental and land use case law. The section also summarizes Florida Legislation from the 2001 Legislative session. Readers may also research these topics online at the official website of the Florida Legislature, www.leg.state.fl.us, the Florida Department of Environmental Protection's website, www.dep.state.fl.us, and the Florida Department of Community Affairs' website, www.dca. state.fl.us.

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

Professor Fred Bosselman of the Chicago-Kent College of Law specializes in energy, land-use, and environmental law. In his ground-breaking article, What Lawmakers Can Learn From Large-scale Economy, Professor Bosselman argues that laws regulating management of natural resources and environmental protection must be amended to incorporate current scientific knowledge. Today, ecological scientists have dramatically expanded their ability to study the natural world in large quantities, both spatially and temporally. Although ecology still gains many insights from analysis of small-scale phenomena, large-scale ecology is beginning to make us realize that ecological systems are more than just the sum of their parts. Current research in large-scale ecology offers interesting lessons that should be useful in fashioning the environmental laws of the twenty-first century. For example, we have learned that if humans can keep their alteration of nature within parameters that ecological systems have experienced in the past, the systems are likely to retain existing ecological functions over broad scales of time and place. The key question is whether scientists can identify the limits beyond which we risk ecological collapse, and whether we can develop laws and policies that will keep us within those limits.

Hoang Dang, *New Power, Few New Lines: A Need for a Federal Solution*, 17 J. LAND USE & ENVTL. L. 333 (2002).

In this article, winner of the *Journal of Land Use & Environmental Law's* Patsy Ford & David Bloodworth Memorial Scholarship, the author discusses the problems facing the electric industry as the chains of monopolistic power and intense regulation are removed and the industry is transformed into a deregulated and competitive market. Looking back at key pieces of federal legislation and regulation, the author maps out the road that was intended to lead to a healthy array of increased competition and significant benefits to consumers but, instead, delivered the industry into a quandary of transmission congestion, safety risks, and negation of consumer savings. The author then discusses the Federal Energy Regulatory Commission's efforts to respond to this problem through the development of regional transmission organizations (RTOs), intended to be responsible for the planning and expansion of transmission lines, and the barriers impeding federal efforts to effectuate positive change through construction and expansion of transmission lines. Next, the author provides the reader with a thorough discussion of proposed solutions to the current state of affairs and recommends a proposal involving a combination of state reform measures and federal preemption. Finally, the author progresses into an analysis of the constitutional implications of her recommended solution under the Commerce Clause and Tenth Amendment and concludes that retention of exclusive control over transmission siting by the states is not in the best interest of an industry having significant national implications and that amendment to federal legislation is both necessary and feasible to solve the electric industry's quandary of transmission congestion, safety risks, and waste of consumer benefits.

Sidney F. Ansbacher & Joe Knetsch, *Negotiating the Maze: Tracing Historical Title Claims in Spanish Land Grants and Swamp and Overflowed Lands Act*, 17 J. LAND USE & ENVTL. L. 357 (2002)

This article discusses the treatment of submerged sovereignty lands transferred to the United States through quitclaim transactions; states acquiring such lands were instructed that they be used to benefit the public interest and, as such, transfer was prohibited unless it would advance such interests. For comparison, the article also traces the acquisition and treatment of those lands which Florida took title to upon statehood as swamp and overflowed lands to be used, conversely, for purposes of internal improvement. To distinguish between the treatment of the lands acquired through

the different methods, the article traces the various state and federal legislative acts enacted to deal with both. The ultimate goal of the authors in this article is to address the difficultly in properly evaluating the validity of public and private claims to submerged sovereignty lands and swamp and overflowed lands that arise as a result of the differing treatments.

John T. Cardillo, *Recommended Web Sites For National and Florida Parks*, 17 J. LAND USE & ENVTL. L. 469 (2002).

Many fond memories are created during vacations. This section provides readers with a brief review of websites for national and Florida parks which will hopefully facilitate memorable journeys. The Journal's annual website review attempts to assist the legal practitioner in taking advantage of the free resources available on the internet when researching environmental and land use issues. Past reviews include Endangered Species and Ocean and Coastal law.

Kara J. Berlin, *Recent Development in Land Use & Environmental Law*, 17 J. LAND USE & ENVTL. L. 483 (2002).

This section highlights recent developments in federal and state environmental and land use case law. Readers may also research these topics online at the official website of the Florida Legislature, www.leg.state.fl.us, the Florida Department of Environmental Protection's website,www.dep.state.fl.us, and the Florida Department of Community Affairs' website at www.dca.state.fl.us.

Roman Ortega-Cowan, Book Review: WELL GROUNDED: USING LOCAL LAND USE AUTHORITY TO ACHIEVE SMART GROWTH**.** By John R. Nolon. 17 J. LAND USE & ENVTL. L. 497 (2002).

Professor Nolon presents a large body of interesting and important information in an easily accessible format. Although the focus is primarily on New York land use law, the book serves a dual purpose: New York citizens and officials may use it as a practical guide and students throughout the country may use it to learn of a valuable strategy that may (and arguably should) be employed by all fifty states.