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Transforming the Means and Ends of Natural Resource Management

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TRANSFORMING THE MEANS AND ENDS OF NATURAL RESOURCES MANAGEMENT*

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This Article considers how prominent goals of natural resources law and the prevailing model of regulatory decision making combine to limit the capacity of natural resources governance to manage the effects of climate change. The Article explores the implications of continuing to rely on conventionally static and fragmented decision making, passive management, and historical preservation when global climatic shifts are widely expected to lead to rapid changes in ecological systems that are unforeseen, novel, and potentially detrimental to ecological diversity and function. This emphasis of natural resources management on stasis arises from the legal system's discomfort with integrating and managing uncertainty and change. As an accelerant, climate change makes this rigidity particularly evident and unsustainable. The Article ultimately argues for the need to change both the means and the ends of natural resources law to better deal with change and uncertainty, as well as inform and galvanize public deliberation on natural resource decisions.

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INTRODUCTION

Existing natural resources law in the United States is poorly suited to foster effective human and ecological adaptation[1] to the effects of climate change on natural resources for two reasons—one procedural, the other substantive. First, natural resource decision-making processes exhibit poor adaptive capacity because they are not designed to incentivize intra-agency learning or to make use of existing opportunities for interjurisdictional learning.[2] As uncertainty is one of the largest threats to natural resources management arising from global climate change, most natural resources management authorities lack sufficient capacity to engage in meaningful climate change adaptation planning.

Second, key preservationist goals of natural resources law premised on *historical preservation* (the protection of resources or landscapes in their historical condition) or *passive management* (minimizing human

1. Unlike climate change mitigation strategies, which focus on how to minimize or regulate greenhouse gas air emissions to prevent or reduce further climate change, climate change adaptation strategies concentrate on how to manage and reduce the detrimental climate change-related effects on natural and human systems. *See* WILLIAM E. EASTERLING III ET AL., PEW CTR. ON GLOBAL CLIMATE CHANGE, COPING WITH GLOBAL CLIMATE CHANGE: THE ROLE OF ADAPTATION IN THE UNITED STATES, at iii (2004), *available at* http://www.pewclimate.org/docUploads/Adaptation.pdf; Intergovernmental Panel on Climate Change, *Appendix I: Glossary*, *in* CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY, CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 869, 869 (Martin Parry et al. eds., 2007) [hereinafter IMPACTS, ADAPTATION AND VULNERABILITY]. As a result, they are fundamentally different, but possibly complementary, enterprises. *See* U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 11 (2009), *available at* http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf ("Mitigation and adaptation are both essential parts of a comprehensive climate change response strategy.").

2. *See infra* Part I.

involvement with nonhuman systems) will be increasingly costly, difficult, and even impossible to meet.[3] As the most prominent federal example of historical preservation, the National Parks Organic Act tethers the national park system to a historical baseline with its central purpose of maintaining "the scenery and the natural and historic objects and the wild life therein . . . unimpaired for the enjoyment of future generations."[4] The fundamental mandate of the Wilderness Act, the primary federal example of passive management, is the protection of areas "where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain."[5] By exerting increased stress on already taxed ecosystems and causing or accelerating fundamental ecological changes from prior conditions, climate change makes the significant costs and ultimate unsuitability of the National Parks Organic Act's historical preservation and the Wilderness Act's passive management goals particularly evident. Because it pits historical preservation and passive management goals against each other, and potentially against concerns for long-term ecological function, climate change makes profound modification in natural resources law essential.

The procedural and substantive limitations of natural resources law are interrelated, as are the solutions to those limitations. Natural resources law in the United States has traditionally emphasized static models of nature (to what end should we manage natural systems) and of decision making (how we learn and decide). The reliance of natural resources management on static decision making on the one hand, and passive management and historical preservation on the other, depend on and reinforce each other. This emphasis on stasis arises from the legal system's traditional discomfort with integrating and managing uncertainty and change. To address this, both the means and ends of natural resources law and management must be refashioned to better adapt to a dynamic world. This includes an increased emphasis not on preserving the past or minimizing human involvement, but rather on limiting bad interactions and promoting the function of valuable ecological processes and constituents. Because this substantive vision of natural resources management is less expert-driven and scientific, it also emphasizes that natural resources law's core function should be improving the process of natural resource decision making. This includes a regulatory process premised on promoting stakeholder involvement, cultivating agency and stakeholder learning, and reducing uncertainty over time. In addition, the adaptive governance process

3. *See infra* Part II.
4. 16 U.S.C. § 1 (2006).
5. *Id.* § 1131(c).

recognizes that resource management decisions, such as whether or not to introduce a species into an area outside of its preexisting range, at their core are not only technical, but in fact fundamentally normative or political.

This Article explores the relationship between these embedded models of nature and decision making, and how these assumptions limit the capacity of existing regulatory systems to manage the effects of climate change on natural resources in the United States. Part I explores how existing regulatory institutions are poorly suited to foster effective natural resource adaptation because they are not designed to cultivate systematic learning and manage uncertainty. Part II explores the static view of nature enshrined in particular substantive goals of natural resources law. In this context, it considers the implications of the conservation movement's emphasis on historical preservation. Part III discusses the link between these two static visions, how they are mutually reinforcing, and how the solutions to their shortcomings are connected as well. Part IV professes the need to change both the means and the ends of natural resources law to better deal with change and uncertainty as well as inform and galvanize public deliberation on natural resource decisions.

I. THE WEAK ADAPTIVE CAPACITY OF NATURAL RESOURCE PROCESSES

The biggest threat to natural resources management that accompanies climate change is information uncertainty. Unfortunately, existing government institutions for managing natural resources are not sufficiently designed to encourage the reduction and management of uncertainty.[6] Moreover, the current natural resources regulatory system fails to take advantage of the significant opportunities for interjurisdictional learning that exist.[7] As a result, the existing framework for managing natural resources in the United States lacks adequate capacity to develop effective strategies for preparing for and weathering the current and future effects of climate change.

A. Climate Change Adaptation and Uncertainty

Uncertainty is prevalent in environmental governance. In fact, some scholars consider uncertainty to be a defining characteristic of environmental problems.[8] However, the uncertainty accompanying climate

6. *See infra* Part I.A.

7. *See infra* Part I.B.

8. JAMES SALZMAN & BARTON H. THOMPSON, JR., ENVIRONMENTAL LAW AND POLICY 15 (3d ed. 2010) ("In many respects scientific uncertainty is *the* defining feature of environmental policy."); Jonathan Remy Nash, *Standing and the Precautionary Principle*, 108 COLUM. L. REV. 494, 498–99 (2008); Talbot Page, *A Generic View of Toxic Chemicals and Similar Risks*, 7 ECOLOGY L.Q. 207, 208 (1978) ("Ignorance of mechanism is the first characteristic of

change adaptation is of a different order of magnitude than conventional environmental problems.

As alarming as the current and projected consequences from anthropogenic climate change are, the primary concern of natural resources law over the next several decades should not be the direct ecological effects from climate change. There is considerable reliable evidence that climate change is having (and will increasingly have) substantial negative effects on ecological systems and processes. Extensive scientific data indicates that climate change has caused significant harm to wildlife, vegetation, and ecological processes,[9] including biota in the United States.[10] The effects on

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environmental risk problems.") (emphasis omitted).

9. *See, e.g.*, CAMILLE PARMESAN & HECTOR GALBRAITH, PEW CTR. ON GLOBAL CLIMATE CHANGE, OBSERVED IMPACTS OF CLIMATE CHANGE IN THE U.S. 17–34 (2004), *available at* www.pewclimate.org/docUploads/final_ObsImpact.pdf (reporting the effects of climate change in the United States); Intergovernmental Panel on Climate Change, *Summary for Policymakers*, *in* CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 1, 2–5 (Susan Solomon et al. eds., 2007) [hereinafter THE PHYSICAL SCIENCE BASIS] (listing the human drivers of climate change); Camille Parmesan, *Ecological and Evolutionary Responses to Recent Climate Change*, 37 ANN. REV. ECOLOGY EVOLUTION & SYSTEMATICS 637, 639 (2006) ("[T]he direct impacts of anthropogenic climate change have been documented on every continent, in every ocean, and in most major taxonomic groups.") (citations omitted); Camille Parmesan & Gary Yohe, *A Globally Coherent Fingerprint of Climate Change Impacts Across Natural Systems*, 421 NATURE 37, 41 (2003) (discussing the substantial detrimental effects of climate change); Martin L. Parry et al., *Summary for Policymakers*, *in* IMPACTS, ADAPTATION AND VULNERABILITY, *supra* note 1, at 7, 8–9 (listing observed impacts of climate change on the natural and human environment); Boris Worm et al., *Impacts of Biodiversity Loss on Ocean Ecosystem Services*, 314 SCIENCE 787, 787–90 (2006) (discussing the effect of aquatic biodiversity loss on ocean ecosystems).

10. *See, e.g.*, CAL. ENVTL. PROT. AGENCY, INDICATORS OF CLIMATE CHANGE IN CALIFORNIA, at ii–iii, 146–65 (Linda Mazur & Carmen Milanes eds., 2009), *available at* http://www.oehha.ca.gov/multimedia/epic/pdf/ClimateChangeIndicatorsApril2009.pdf (reporting decreased spring snowmelt, rising sea levels, increased frequency of wildfires, accelerated wine grape blooming, and changes in bird, small mammal, and butterfly migration patterns in California); THE H. JOHN HEINZ III CTR. FOR SCI., ECON. & THE ENV'T, THE STATE OF THE NATION'S ECOSYSTEMS 2008: FOCUS ON CLIMATE CHANGE 2–4 (2008), *available at* http://www.heinzctr.org/ecosystems/2008report/pdf_files/ Climate_Fact_Sheet.pdf (summarizing indicators of climate change in the United States); U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 1, at 27–40 (describing climate change in the United States); Peter Backlund et al., *Executive Summary*, *in* THE EFFECTS OF CLIMATE CHANGE ON AGRICULTURE, LAND RESOURCES, WATER RESOURCES, AND BIODIVERSITY IN THE UNITED STATES: A REPORT BY THE U.S. CLIMATE CHANGE SCIENCE PROGRAM AND THE SUBCOMMITTEE ON GLOBAL CHANGE RESEARCH 1, 4–5 (Margaret Walsh ed., 2008) [hereinafter THE EFFECTS OF CLIMATE CHANGE], *available at* http://www.sap43.ucar.edu/documents/SAP_4.3_6.18.pdf (exploring how changes in climate exacerbate or ameliorate stresses on agriculture, land resources, water resources, and biodiversity); Lisa Crozier, *Warmer Winters Drive Butterfly Range Expansion by Increasing Survivorship*, 85 ECOLOGY 231, 239–40 (2004) (explaining the northward movement of the sachem skipper butterfly range); Alan T. Hitch & Paul L. Leberg, *Breeding Distributions of North American Bird Species Moving North as a Result of Climate Change*, 21 CONSERVATION BIOLOGY 534, 534 (2007) ("As predicted, the northern limit of birds with a southern distribution

ecological and human systems from projected future climate change are expected to be substantially greater, with particular harm in the United States to forest, coastal, and freshwater resources.[11]

Nonetheless, the exceptional uncertainty that exists for natural resource adaptation efforts will likely be at least as significant a barrier to functional management of the effects of climate change on natural systems as these direct ecological effects themselves. The projected breadth, severity, and speed of climate change threaten to move many vital and productive ecosystems outside their range of historical variability.[12] Unfortunately, this unprecedented change not only jeopardizes the fundamental resilience, and thus existence of, these ecosystems,[13] but also makes extrapolations from current ecological knowledge of limited value. Furthermore, the global scale of the problem, the inevitably limited study of the effects of climate change,[14] and the complex interaction between a host of climatic variables[15] raise considerable uncertainty for the

showed a significant shift northward (2.35 km/year)."); David W. Inouye et al., *Climate Change Is Affecting Altitudinal Migrants and Hibernating Species*, 97 PROC. NAT'L ACAD. SCI. 1630, 1632–33 (2000); Parmesan, *supra* note 9, at 643–44 (noting the acceleration in bloom dates (phytoplankton), flowering dates (flowers), calling dates (frogs), and spring events (birds) for certain species); Monika Winder & Daniel E. Schindler, *Climate Change Uncouples Trophic Interactions in an Aquatic Ecosystem*, 85 ECOLOGY 2100, 2102–05 (2004).

11. *See* PETER C. FRUMHOFF ET AL., THE NORTHEAST CLIMATE IMPACTS ASSESSMENT, CONFRONTING CLIMATE CHANGE IN THE U.S. NORTHEAST: SCIENCE, IMPACTS, AND SOLUTIONS 47 (2007), *available at* http://www.climatechoices.org/assets/documents/climatechoices/confronting-climate-change-in-the-u-s-northeast.pdf; David M. Lawrence et al., *Accelerated Arctic Land Warming and Permafrost Degradation During Rapid Sea Ice Loss*, 35 GEOPHYSICAL RES. LETTERS L11506, at 5 (2008); Parry et al., *supra* note 9, at 10–12 (projecting with very high confidence increased harm to coastal and freshwater resources); M.G. Ryan et al., *Land Resources: Forests and Arid Lands*, *in* THE EFFECTS OF CLIMATE CHANGE, *supra* note 10, at 75, 96–103 (projecting greater disturbance to forests from fire, pestilence, and disease).

12. *See, e.g.*, Parry et al., *supra* note 9, at 11 ("The resilience of many ecosystems is likely to be exceeded this century."); Frank J. Rahel et al., *Managing Aquatic Species of Conservation Concern in the Face of Climate Change and Invasive Species*, 22 CONSERVATION BIOLOGY 551, 557 (2008) ("Climate changes . . . may cause environmental conditions to exceed the historic range of variability to which species are adapted in a particular region.").

13. *See* Parry et al., *supra* note 9, at 11; Stephen H. Schneider et al., *Climate-Change Scenarios for Impact Assessment*, *in* GLOBAL WARMING AND BIOLOGICAL DIVERSITY 38, 53 (Robert L. Peters & Thomas L. Lovejoy eds., 1992).

14. *See* Parry et al., *supra* note 9, at 9 ("[A]vailable analyses are limited in the number of systems and locations considered.").

15. A number of features of climate dynamics remain difficult to predict and/or poorly understood. Some features, such as melting permafrost, may lead to a vicious cycle of warming, but the extent of these nonlinear effects is unclear. *See* Katey M. Walter et al., *Methane Bubbling from Northern Lakes: Present and Future Contributions to the Global Methane Budget*, 365 PHIL. TRANSACTIONS ROYAL SOC'Y A 1657, 1671 (2007). Similarly, the influence of potentially confounding natural factors is unclear. *See* Richard A. Kerr, *Another Global Warming Icon Comes Under Attack*, 317 SCIENCE 28, 28 (2007) (considering how emitted aerosols may

development of effective climate change mitigation and adaptation strategies.[16]

Yet climate change adaptation efforts face even greater uncertainty than mitigation strategies. As compared to scientific models of global climate temperatures and sea levels for developing mitigation strategies, modeling for adaptation decisions requires the additional step of "downscaling," which takes global models and attempts to project how such changes in global temperature will affect local conditions and resources.[17] For example, to project the effects of climate change on a particular species, accurate models would need to input (often nonexistent) data on the existing range and dispersal characteristics of that species and other ecologically linked species, and forecast how local climatic changes might shift such ranges when combined with other dispersal barriers. Of course, the localized impacts of climate change will vary greatly depending on the adaptability of each ecosystem[18] and many local nonclimate factors, such as population shifts and income, existing land uses, technological development, and invasive species.[19] Many additional assumptions beyond those for global modeling are necessary, and small changes in these assumptions can lead to widely varying results.[20] Consequently, localized modeling of the effects of climate change remains much more inchoate and less reliable than the modeling used to inform decisions on mitigation.[21] Of

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counteract warming by deflecting solar radiation); J. T. Randerson et al., *The Impact of Boreal Forest Fire on Climate Warming*, 314 SCIENCE 1130, 1130 (2006) (discussing evidence that increased forest fires may reduce temperatures in the long term because of increased surface reflectivity). In addition, some climatic features will likely be discovered only after additional climatic changes occur. *Cf.* J.B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B.U. L. REV. 1, 19 (2008) ("[E]ven as we learn more about the highly coupled, tightly interacting processes that comprise the climate, the likelihood is that we will realize with even greater clarity that it is inherently unpredictable.").

16. *See* Ruhl, *supra* note 15, at 22 ("[C]limate change does not present just another disturbance regime, the operations of which we can extrapolate from current ecological knowledge; rather, it will be the undoing of ecosystems as we know them."); Joseph A. Siegel, *Collaborative Decision Making on Climate Change in the Federal Government*, 27 PACE ENVTL. L. REV. 257, 259 (2009).

17. *See* Climate and Land Use Change Effects on Ecological Resources in Three Watersheds: A Synthesis Report, 72 Fed. Reg. 45,045, 45,046 (Aug. 10, 2007) (notice of public comment).

18. *See* Parry et al., *supra* note 9, at 11.

19. *See id.* at 20.

20. *See, e.g.*, DAVID C. BADER ET AL., U.S. CLIMATE CHANGE SCI. PROGRAM & THE SUBCOMM. ON GLOBAL CHANGE RESEARCH, CLIMATE MODELS: AN ASSESSMENT OF STRENGTHS AND LIMITATIONS 88 (2008), *available at* www.sc.doe.gov/ober/sap3-1-final-all.pdf ("[M]aking different assumptions about the land biosphere within a single model gave markedly different feedback values.").

21. *See* Parry et al., *supra* note 9, at 9 ("[T]emperature variability is larger at the regional than at the global scale . . . . [A]t the regional scale other factors (such as land-use change,

course, such uncertainty is amplified by the fact that the effects of global climate change on ecosystems will be influenced by two other factors for which there remains limited information: the extent of mitigation strategies to be employed to abate further climatic change[22] and the collateral effects on biota from adaptation strategies likely to be adopted to protect human-dominated landscapes.[23]

Together these factors elevate uncertainty to an unprecedented level,[24] forcing scientists to reexamine or even discard conventional assumptions and methods, and making regulators assess and manage problems they have never faced before. In this uncertain regulatory environment, natural resources governance must be primarily concerned with maximizing natural resources institutions' capacity to assess, manage, and reduce uncertainty where possible. Accordingly, though the development of substantive strategies for adapting natural and human systems to the physical effects of climate change will be vital, some of the most important strategies to facilitate effective adaptation to the effects of climate change will be those that encourage regulators and stakeholders to manage uncertainty through learning. This includes generating and gathering information about current and projected effects and past, existing, and potential future management strategies, as well as promoting the integration of such information throughout the regulatory and resource management process.

B. Existing Governance Hinders Effective Management of Uncertainty

Unfortunately, the natural resources governance system in the United States is poorly suited to foster effective natural resource adaptation because it is not designed to foster learning. This is due to two basic features. First, most natural resource programs do not sufficiently encourage managers and regulators to learn, manage uncertainty, or make management more effective at achieving regulatory goals. Second, natural resources governance is generally characterized by fragmented and largely uncoordinated authority that is limited in its capacity to promote interjurisdictional information sharing and collaboration that can help

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pollution, and invasive species) are influential."); Susan Solomon et al., *Technical Summary*, *in* THE PHYSICAL SCIENCE BASIS, *supra* note 9, at 19, 74 boxTS.10 ("There remain a number of important sources of uncertainty limiting the ability to project regional climate change.").

22. *See* EASTERLING ET AL., *supra* note 1, at iii.

23. *See* Intergovernmental Panel on Climate Change, *supra* note 9, at 3–4; Ruhl, *supra* note 15, at 24–26 (explaining the secondary ecological and human adaptation effects of climate change); Solomon et al., *supra* note 21, at 42–43.

24. *See* Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1, 14–15 (2009); Siegel, *supra* note 16, at 266.

reduce uncertainty about both the efficacy of management strategies and the effects of climate change. Because it lacks a sufficient infrastructure for cultivating learning and information sharing, the current federal system of natural resources management has and will continue to have considerable difficulty managing and reducing uncertainty.

1. Front-end, Static Government Decision Making

Most American natural resource programs are not designed to manage uncertainty or reduce mistakes that are almost certain to occur when facing unclear regulatory problems. Natural resources law fails to encourage resource managers to systematically monitor[25] and adjust management decisions to make them more effective at achieving program goals.[26] Even for more conventional environmental problems, agencies inevitably have limited information about the relevant environment and effects of proposed actions. In this context, agencies regularly adopt strategies that subsequent data may demonstrate are insufficient or for which background conditions shift such that the strategy is no longer as effective as previously expected.[27]

However, agencies are not required or encouraged to monitor past decisions, adjust such decisions to reflect new information or changed circumstances, or be more effective over time at achieving regulatory goals. Though statutes and regulations routinely require post-decision monitoring, and while agencies expressly acknowledge the importance of accountability,[28] agency attention to such directives is notoriously deficient.[29] Agencies rarely even assess whether prior background

25. *See* Eric Biber, *The Problem of Environmental Monitoring*, 83 U. COLO. L. REV. (forthcoming 2011) (manuscript at 32–34) (on file with the North Carolina Law Review) (highlighting numerous obstacles, both internal and external, that agencies face in the development of monitoring programs).

26. *See* Camacho, *supra* note 24, at 64.

27. *See* Bradley C. Karkkainen, *Collaborative Ecosystem Governance: Scale, Complexity, and Dynamism*, 21 VA. ENVTL. L.J. 189, 201 (2002).

28. Alejandro E. Camacho, *Can Regulation Evolve? Lessons from a Study in Maladaptive Management*, 55 UCLA L. REV. 293, 324–25 (2007).

29. *See* MGMT. SYS. INT'L, AN INDEPENDENT EVALUATION OF THE EFFECTIVENESS OF THE U.S. FISH AND WILDLIFE SERVICE'S NATIONAL WILDLIFE REFUGE SYSTEM 20 (2008), *available at* http://www.fws.gov/refuges/policiesandbudget/independentEval.html ("[O]nly 11% of refuge managers surveyed described the current level of inventory and monitoring work as being mostly or fully sufficient."); Biber, *supra* note 25 (manuscript at 40–49) (detailing substantial agency incentives to not carry out ambient monitoring); Camacho, *supra* note 28, at 324–28; Jody Freeman, *Collaborative Governance in the Administrative State*, 45 UCLA L. REV. 1, 28–29 (1997).

assumptions were accurate or whether prior decisions are actually achieving regulatory goals.[30]

Moreover, statutes and regulations do not require most agencies to work with and reduce uncertainty by adjusting adopted strategies over time.[31] In most instances, virtually all agency attention and resources are directed at the initial decision, regardless of how little information there is to make the decision.[32] Once an initial decision is made, whether regarding an individual project or an entire program, the agency rarely revisits it in any systematic way to adjust the decision or learn from its successes or limitations for future actions.[33] In this sense, natural resource decision making reflects a static, front-end approach to resource regulation and management.

Many scholars in the legal and scientific literature have called for the use of "adaptive management" protocols that seek to account for new information or changes in circumstances through persistent monitoring, assessment, and adjustment of resource management decisions.[34] Concurrently, a growing number of natural resource agencies have adopted these experimental strategies.[35] Adaptive management was developed precisely to help resource managers deal with uncertainty in the regulatory process.[36] Ideally, through adaptive management government officials can

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30. Camacho, *supra* note 28, at 332–35.

31. *See* Camacho, *supra* note 24, at 37–38; Freeman, *supra* note 29, at 16–17.

32. *See* Camacho, *supra* note 24, at 38; Camacho, *supra* note 28, at 324; Karkkainen, *supra* note 27, at 200–01.

33. *See* Camacho, *supra* note 24, at 38; Camacho, *supra* note 28, at 324.

34. For scientific literature, see, for example, GEORGE H. STANKEY ET AL., U.S. DEP'T OF AGRIC., ADAPTIVE MANAGEMENT OF NATURAL RESOURCES: THEORY, CONCEPTS, AND MANAGEMENT INSTITUTIONS 31–33 (2005), *available at* www.fs.fed.us/pnw/pubs/pnw_gtr654.pdf; CARL WALTERS, ADAPTIVE MANAGEMENT OF RENEWABLE RESOURCES 257 (1986); C.S. Holling, *The Spruce Budworm/Forest-Management Problem*, *in* ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT 143, 156 (C.S. Holling ed., 1978). For legal scholarship encouraging integration of ongoing monitoring and adaptation in regulation, see, for example, Michael C. Dorf & Charles E. Sabel, *A Constitution of Democratic Experimentalism*, 98 COLUM. L. REV. 267, 285 (1998); Freeman, *supra* note 29, at 28–29; Bradley C. Karkkainen, *"New Governance" in Legal Thought and in the World: Some Splitting as Antidote to Overzealous Lumping*, 89 MINN. L. REV. 471, 496 (2004).

35. *See, e.g.*, Notice of Availability of a Final Addendum to the Handbook for Habitat Conservation Planning and Incidental Take Permitting Process, 65 Fed. Reg. 35,242, 35,252 (June 1, 2000) (detailing U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration guidance requiring adaptive management strategies under the Endangered Species Act for certain habitat conservation plans ("HCPs")). *See generally* BYRON K. WILLIAMS ET AL., ADAPTIVE MGMT. WORKING GRP., ADAPTIVE MANAGEMENT: THE U.S. DEPARTMENT OF THE INTERIOR TECHNICAL GUIDE (2009), *available at* http://www.doi.gov/initiatives/AdaptiveManagement/TechGuide/opening pgs.pdf (adopting policy guidance for the Department of the Interior seeking incorporation of adaptive management "into pertinent internal programmatic guidance" to be considered for use in certain situations).

36. WALTERS, *supra* note 34, at 257; Camacho, *supra* note 24, at 23; Holling, *supra* note 34,

act using the limited data they initially possess (rather than wait to act until such data is certain) with the knowledge that the strategy can be changed later as more information becomes available or conditions change.[37] Adaptive management can also be employed to assess background assumptions such as a reliance on historical conditions as a baseline for projecting future trends.[38] As a result, scholars and agencies increasingly endorse the incorporation of adaptive management to cope with the uncertainty likely to arise with climate change.[39]

Nonetheless, to date most attempts to use adaptive management fail to require or encourage resource managers to learn from their management decisions.[40] Many such adaptive management experiments have failed to provide agency officials with significant resources or other incentives to implement monitoring and adaptive management.[41] A number of adaptive management programs have failed to provide clear objectives for experiments to be assessed against, or specific criteria or triggers for when strategies must be adjusted to reflect new information or changed circumstances.[42] Monitoring of past decisions is usually required, but often deficient.[43] Even programs that claim to promote the use of adaptive management rarely require it, and when adaptive management is

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at 156.

37. *See* Joseph Arvai et al., *Adaptive Management of the Global Climate Problem: Bridging the Gap Between Climate Research and Climate Policy*, 78 CLIMATIC CHANGE 217, 219 (2006).

38. *See* Linda A. Joyce et al., *National Forests*, *in* PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS AND RESOURCES 19, 47 (Susan Herrod Julius & Jordan M. West eds., 2008) [hereinafter ADAPTATION OPTIONS], *available at* http://downloads.climatescience.gov/sap/sap4-4/sap4-4-final-report-all.pdf.

39. *See* U.S. FISH & WILDLIFE SERV., RISING TO THE URGENT CHALLENGE: STRATEGIC PLAN FOR RESPONDING TO ACCELERATING CLIMATE CHANGE 15–17 (2010), *available at* http://www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf (incorporating adaptive management into a framework for addressing climate change); J. Michael Scott et al., *National Wildlife Refuges*, *in* ADAPTATION OPTIONS, *supra* note 38, at ch. 5, 37; Emma L. Tompkins & W. Neil Adger, *Does Adaptive Management of Natural Resources Enhance Resilience to Climate Change?*, ECOLOGY & SOC'Y (Dec. 2004), http://www.ecologyandsociety.org/vol9/iss2/art10/main.html.

40. *See* Camacho, *supra* note 24, at 40–42, 47–48 (noting, among other examples, that "USFWS does not systematically collect or assess information about HCPs to allow or direct agency personnel to learn about the relative value of different negotiating, monitoring, and management strategies").

41. *See* R. Gregory et al., *Deconstructing Adaptive Management: Criteria for Applications to Environmental Management*, 16 ECOLOGICAL APPLICATIONS 2411, 2413 (2006) (noting that a lack of institutional support can make applying adaptive management very difficult); Scott et al., *supra* note 39, at 29.

42. *See* Dave Owen, *Law, Environmental Dynamism, Reliability: The Rise and Fall of CALFED*, 37 ENVTL. L. 1145, 1199 (2007); Lawrence Susskind et al., *Collaborative Planning and Adaptive Management in Glen Canyon: A Cautionary Tale*, 35 COLUM. J. ENVTL. L. 1, 35–38 (2010).

43. *See* Camacho, *supra* note 28, at 324–28.

incorporated into an initial regulatory decision actual subsequent adjustment of that strategy is even less common.[44]

Perhaps more important than gathering and integrating information about background conditions and the actual environmental effects of adopted strategies, these regulatory programs do not require the collection and assimilation of information about the efficacy of adopted regulatory strategies, program processes, or the agency as a whole at achieving the program's goals.[45] They do not systematically direct or otherwise urge agency officials to learn about the relative value of different management strategies[46] or provide such officials ready access to the experience of similarly situated officials in the same or other agencies.[47] As a consequence, conventional regulatory programs and existing regulatory experiments typically do not systematically gather information about the performance of previously adopted strategies or assess whether such strategies or programs have been effective at achieving stated goals.[48]

In essence, existing natural resources law has failed to establish any systemic capacity to manage or reduce uncertainty through learning. The absence of a framework for gathering and using information pertinent to the regulatory process results in weak agency accountability, as not only the agency but also Congress, stakeholders, and the public have limited credible information to use to promote changes that make management strategies more effective.[49] More significantly in the context of climate change, this lack of information about management practices compounds the substantial uncertainty that agencies confront in managing natural systems that are changing in unpredictable ways. Natural resources law needs to develop a comprehensive framework that encourages agencies to manage and reduce uncertainty about changing natural systems and the regulatory programs that they employ.

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44. *See id*. at 332–35; Owen, *supra* note 42, at 1199, 1204 (indicating that though CALFED purported to use adaptive management practices and was deemed exemplary at its outset, it failed to sustain enduring adaptive management).

45. *See* Alejandro E. Camacho, *Beyond Conjecture: Learning About Ecosystem Management from the Glen Canyon Dam Experiment*, 8 NEV. L.J. 942, 955–56 (2008).

46. *See* Camacho, *supra* note 24, at 29; Camacho, *supra* note 28, at 336–42; Bradley C. Karkkainen, *Bottlenecks and Baselines: Tackling Information Deficits in Environmental Regulation*, 86 TEX. L. REV. 1409, 1442 (2008) (stating that inadequate information about environmental conditions, regulatory strategies, and agency performance has contributed to the failure of certain regulatory experiments).

47. *See, e.g.*, Camacho, *supra* note 28, at 341; Karkkainen, *supra* note 34, at 495 ("[R]esponsibility for negotiating HCPs and enforcing their terms was a responsibility assigned to regional and field offices, each operating largely by its own lights.").

48. *See* Camacho, *supra* note 28, at 341.

49. *See* Camacho, *supra* note 45, at 957.

2. Fragmentation and Intergovernmental Information Sharing

Existing regulatory fragmentation (with, at best, weak coordination among authorities) also hinders agency adaptation and fails to promote inter-jurisdictional information sharing that can promote learning and help regulatory authorities manage uncertainty. Natural systems in the United States are generally subject to a patchwork of piecemeal and overlapping management, divided based, among other things, on (1) the protected resource or resource feature, (2) the level of government, (3) the branch of government, and (4) the regulatory stage.[50] The existing natural resources management system in the United States was not designed with climate change in mind, or for landscape-wide shifts in climate across jurisdictional boundaries. Rather, it was designed under the paradigm of allowing a wide range of different regulatory authorities to each manage a set of narrow and discrete, but often overlapping, resource problems.[51]

Though such decentralized regulatory authority allows for the possibility of innovation and inter-jurisdictional learning,[52] currently regulatory authorities neither have the incentives nor genuine opportunities to learn from other similarly situated resource managers. Not only do such authorities lack relevant information, they also lack the capacity to obtain such information. The absence of such an information infrastructure is a recipe for disaster with the onset of global climate change, which is likely to increase the possibility of resource scarcity and conflict, the interaction of jurisdictions, and the potential for regulatory overlap between regulatory authorities.

a. Fragmentation and Climate Change

Existing fragmented governance inhibits not only agency action addressing the effects of climate change but also the capacity for inter-jurisdictional learning that can help reduce uncertainty. Other scholars have detailed how agency inaction can be a detrimental consequence of regulatory fragmentation for large-scale, diffuse resource issues.[53] Climate change adaptation serves as a good example of such a "regulatory

50. *See* William W. Buzbee, *The Regulatory Fragmentation Continuum, Westway and The Challenges of Regional Growth*, 21 J.L. & POL. 323, 342–48 (2005).

51. *See generally* Camacho, *supra* note 24 (discussing regulatory fragmentation in natural resources governance).

52. *See infra* notes 78–82 and accompanying text.

53. *See, e.g.*, J.B. Ruhl & James Salzman, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: A Guide for Whittling Away*, 98 CALIF. L. REV. 59, 61–64 (2010) (discussing agencies' reticence to take on complex problems that cannot be adequately addressed under the jurisdiction of a single agency).

commons."[54] Though climate change's causes and effects are well recognized, they extend across a wide number and range of jurisdictions.[55] As a result of their limited jurisdiction, most agencies with regulatory authority over natural resources have little incentive to engage in adaptation planning and management activities or even to develop the capacity to do so.[56]

In addition, uncoordinated fragmentation severely limits the capacity for agency learning, further exacerbating the enormous uncertainty agencies face from climate change. In the current U.S. natural resources management system, regulators and managers do not have the ability to tap into and learn readily from the strategies or analyses developed by other agency divisions or agencies (in part because such data is not generated and in part because it is not broadly accessible).[57] This lack of information about the efficacy of potential management strategies combines with the limited data on the localized effects of climate change to make many government authorities conclude that they lack the capacity to engage in productive adaptation planning.[58]

Unfortunately, agency officials often choose to focus their energy on more immediate, well-defined concerns than the more nebulous and difficult problems of climate change.[59] Numerous government reports have conceded that the United States is unprepared to manage the effects of climate change.[60] Though some resource agencies are planning and even

54. William W. Buzbee, *Recognizing the Regulatory Commons: A Theory of Regulatory Gaps*, 89 IOWA L. REV. 1, 13–14, 23 (2003).

55. *See* Robin Kundis Craig, *Climate Change, Regulatory Fragmentation, and Water Triage*, 79 U. COLO. L. REV. 825, 828–31, 861 (2008).

56. *See* Buzbee, *supra* note 54, at 30–36 (discussing the high information costs, status quo biases, limited agency credit for being proactive, and the risk aversion of regulators in a fragmented regulatory setting); Camacho, *supra* note 24, at 27–28 (suggesting these conditions exist for adaptation planning).

57. *See, e.g.*, Camacho, *supra* note 28, at 341 ("[T]here is no comprehensive network to facilitate the dissemination of . . . information in other than a haphazard, and likely inefficient, way. . . . [N]egotiation and implementation are conducted by regional and field offices without any centralized or even decentralized coordination. Moreover, the high turnover of [U.S. Fish and Wildlife Service] staff exacerbates this fragmentation problem by further limiting the ability to draw on prior experience. As such, there is, at best, limited cross-pollination of data . . . and certainly far less than could occur.") (footnotes omitted); Karkkainen, *supra* note 34, at 495.

58. *See, e.g.*, U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-07-863, CLIMATE CHANGE: AGENCIES SHOULD DEVELOP GUIDANCE FOR ADDRESSING THE EFFECTS ON FEDERAL LAND AND WATER RESOURCES 155–67 (2007) [hereinafter GAO REPORT 2007], *available at* www.gao.gov/new.items/d07863.pdf (conveying comments by various officials regarding their agencies' limited capacity to respond to climate change); Peter Kareiva et al., *Synthesis and Conclusions*, *in* ADAPTATION OPTIONS, *supra* note 38, at ch. 9, 30–31 (discussing opportunities to positively address climate change based on "management policies and procedures").

59. *See* Camacho, *supra* note 24, at 29.

60. *See, e.g.*, U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-10-113, CLIMATE CHANGE

rolling out adaptation plans,[61] such activities are still limited in development, number, and scope.[62] Today, very few natural resources management activities consider the effects of climate change, and those that do generally concentrate on proposing additional research or information gathering.[63]

b. Problems with Centralization Proposals

One solution commonly offered to address the incentives toward inaction caused by regulatory fragmentation is the consolidation of decision-making authority in fewer and/or more central institutions.[64] A centralization strategy might provide for oversight or substantive review of an agency's activities by a more centralized regulator or for the limited consolidation of a few programs.[65] More extensive consolidation strategies might include federal preemption of state authority or a comprehensive reallocation or restructuring of management responsibility.[66] Two examples of more fundamental consolidation include proposals to integrate federal intelligence gathering and the creation of the Department of Homeland Security.[67]

ADAPTATION: STRATEGIC FEDERAL PLANNING COULD HELP GOVERNMENT OFFICIALS MAKE MORE INFORMED DECISIONS 31 (2009) [hereinafter GAO REPORT 2009], *available at* www.gao.gov/new.items/d10113.pdf; GAO REPORT 2007, *supra* note 58, at 156; THE WHITE HOUSE COUNCIL ON ENVTL. QUALITY, PROGRESS REPORT OF THE INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE: RECOMMENDED ACTIONS IN SUPPORT OF A NATIONAL CLIMATE CHANGE ADAPTATION STRATEGY 14 (2010) [hereinafter INTERAGENCY TASK FORCE REPORT], *available at* http://www.whitehouse.gov/sites/default/files/microsites/ceq/Interagency-Climate-Change-Adaptation-Progress-Report.pdf; JOEL B. SMITH ET AL., PEW CTR. ON GLOBAL CLIMATE CHANGE, ADAPTING TO CLIMATE CHANGE: A CALL FOR FEDERAL LEADERSHIP 2 (2010), *available at* http://www.pewclimate.org/docUploads/adaptation-federal-leadership.pdf; Parry et al., *supra* note 9, at 19–20.

61. *See* INTERAGENCY TASK FORCE REPORT, *supra* note 60, at 22.

62. *See* GAO REPORT 2009, *supra* note 60, at 5; SMITH ET AL., *supra* note 60, at 2.

63. *See* GAO REPORT 2009, *supra* note 60, at 6; *see also id*. at 3 (referencing routine use of strategies based on historically normal conditions despite recognition of the inaccuracy of such assumptions under projected climate change scenarios). Additionally, even those with knowledge of climate change were often unable to apply such knowledge to particular settings. *See id.* at 37–38.

64. *See, e.g.*, Buzbee, *supra* note 54, at 49–51; Matthew D. Fortney, *Devolving Control over Mildly Contaminated Property: The Local Cleanup Program*, 100 NW. U. L. REV. 1863, 1896–1905 (2006).

65. *See* Buzbee, *supra* note 54, at 51.

66. Daniel A. Farber, *Climate Adaptation and Federalism: Mapping the Issues*, 1 SAN DIEGO J. CLIMATE & ENERGY L. 259, 265 (2009).

67. *See generally* Anne Joseph O'Connell, *The Architecture of Smart Intelligence: Structuring and Overseeing Agencies in the Post-9/11 World*, 94 CALIF. L. REV. 1655 (2006) (outlining the reorganization of the intelligence community and discussing the need to find a balance between consolidation and duplication of agency tasks).

In the United States, few have focused on the appropriate allocation of regulatory power among governmental authorities in the context of climate change adaptation. To the extent that such questions arise in the academic literature on climate change, the commentary has almost exclusively focused on issues of federalism and climate change mitigation. In this setting, numerous scholars have discussed whether the federal government should have primacy and preempt state regulation of greenhouse gases.[68] Yet only a few have discussed such questions in the context of adaptation.[69] In addition, though the federal-state relationship is an important one in determining the appropriate allocation of authority for managing natural resources and adapting to climate change, it is not, of course, solely a federalism issue. That is, it is not just a question of the relationship between national and state governments; it is also a question that implicates the allocation of power between federal agencies, local governments, other national governments, and within agencies. However, virtually no scholars or governmental bodies have discussed this broader question.

One of the few proposals in Congress to implicitly address the federal-state relationship in the context of climate change adaptation offered a partial integration of adaptation planning power in the hands of a central federal authority. The Waxman-Markey American Clean Energy and Security Act of 2009 ("ACES")[70] proposed the creation of a White House-chaired Natural Resources Climate Change Adaptation Panel that would include the heads of virtually all federal natural resource agencies.[71] ACES tasked this panel with establishing an integrated Natural Resources Climate Change Adaptation Strategy.[72] Each federal natural resource agency would be required to adopt an adaptation plan determined by the president to be consistent with the strategy.[73] To receive federal funding for adaptation,

68. *See, e.g.*, William W. Buzbee, *State Greenhouse Gas Regulation, Federal Climate Change Legislation, and the Preemption Sword*, 1 SAN DIEGO J. CLIMATE & ENERGY L. 23, 25 (2009); Ann E. Carlson, *Federalism, Preemption, and Greenhouse Gas Emissions*, 37 U.C. DAVIS L. REV. 281, 290 (2003); Alexandra B. Klass, *State Innovation and Preemption: Lessons from State Climate Change Efforts*, 41 LOY. L.A. L. REV. 1653, 1653–55 (2008); Daniel P. Schramm, *A Federal Midwife: Assisting the States in the Birth of a National Greenhouse Gas Cap-and-Trade Program*, 22 TUL. ENVTL. L.J. 61, 65 (2008); Jared Snyder & Jonathan Binder, *The Changing Climate of Cooperative Federalism: The Dynamic Role of the States in a National Strategy to Combat Climate Change*, 27 UCLA J. ENVTL. L. & POL'Y 231, 251 (2009).

69. *See* Farber, *supra* note 66, at 259; Robert L. Glicksman, *Climate Change Adaptation: A Collective Action Perspective on Federalism Considerations*, 40 ENVTL. L. 1159, 1159 (2010).

70. American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong. (2009). Though this bill was passed by the House of Representatives, it was never adopted by the Senate. *See H.R. 2454: American Clean Energy and Security Act of 2009*, GOVTRACK.US, http://www.govtrack.us/congress/bill.xpd?bill=h111-2454 (last visited Apr. 28, 2011).

71. H.R. 2454 § 475.

72. § 476.

73. § 478(a).

states would have to submit an adaptation plan to the secretary of the interior for certification that the plan is consistent with all goals, priorities, and standards established by the panel and in the strategy.[74] Such a proposal would substantially increase centralized oversight and control over federal and state natural resources management.

Though the consolidation or centralization of authority may make sense in some instances to minimize inefficiencies,[75] a close integration of government institutions has the potential to substantially inhibit the many advantages of decentralized decision making. Few scholars have discussed how to allocate regulatory power in formulating adaptation strategies, but the broader literature on federalism and intersystemic governance remains quite relevant. Many commenters have detailed the disadvantages of consolidating or centralizing regulatory authority.[76] Many have noted that decentralized regulation provides the opportunity for the provision of a range of strategies, thus promoting regulatory experimentation and opportunities for regulators and the public to learn about the relative efficacy of different strategies.[77]

In addition, scholars argue that overlapping jurisdiction can counteract the potential for agency capture and groupthink,[78] promote the integration of various specialized subject matter competencies, and harness agency competition to develop more effective regulatory outcomes than coordinated authority.[79] Overlapping authority can also promote agency accountability by harnessing other regulators to monitor compliance and

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74. § 479(b).

75. *See, e.g.*, Jonathan H. Adler, *Jurisdictional Mismatch in Environmental Federalism*, 14 N.Y.U. ENVTL. L.J. 130, 147 (2005) (stating that consolidation of research and information gathering authority at the federal level would be more efficient in situations where "local research into health effects, safe exposure thresholds, and potential control strategies could be duplicative").

76. *See, e.g.*, David E. Adelman & Kirsten H. Engel, *Adaptive Federalism: The Case Against Reallocating Environmental Regulatory Authority*, 92 MINN. L. REV. 1796, 1811–13 (2008); Buzbee, *supra* note 50, at 324–25, 359–61; Ruhl & Salzman, *supra* note 53, at 70–71, 103; Robert A. Schapiro, *Polyphonic Federalism: State Constitutions in the Federal Courts*, 87 CALIF. L. REV. 1409, 1416–17 (1999).

77. *See, e.g.*, David E. Adelman & Kirsten H. Engel, *Adaptive Environmental Federalism*, *in* PREEMPTION CHOICE: THE THEORY, LAW, AND REALITY OF FEDERALISM'S CORE QUESTION 277, 290 (William W. Buzbee ed., 2009) (contending that "adaptive federalism simultaneously sustains competitive legislation and administrative processes that promote the refinement of policies . . . and processes that produce a diverse range of policy options"); Adelman & Engel, *supra* note 76, at 1847–48.

78. *See* IRVING L. JANIS, VICTIMS OF GROUPTHINK 9 (1972) (defining groupthink as "[a] mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members' strivings for unanimity override their motivation to realistically appraise alternative courses of action").

79. *See* Camacho, *supra* note 24, at 67–68; O'Connell, *supra* note 67, at 1676–77; Robert A. Schapiro, *Toward a Theory of Interactive Federalism*, 91 IOWA L. REV. 243, 290 (2005).

the effectiveness of adopted strategies.[80] As a result, many modern normative models of federalism and intersystemic governance assert that decentralized and overlapping authority is vital to cultivating regulatory experimentation, diversity, and effectiveness.[81] The challenge is fostering these benefits of decentralized governance while minimizing any collective action problems.[82]

Particularly in the context of climate change mitigation, many scholars have emphasized the benefits of overlapping state and federal authority in regulating greenhouse gases.[83] Yet even more than for mitigation, natural resources law and climate change adaptation can fit well in the overlapping, decentralized governance model promoted by the adaptive federalism literature. Projecting the local effects of climate change and developing adaptation strategies to address these involves substantially more uncertainty than only projecting atmospheric concentrations of greenhouse gases with and without regulation.[84] As a result, the innovation-promoting features of decentralized governance, which can provide substantial opportunities for regulatory experimentation to reduce uncertainty, could be particularly valuable for natural resource adaptation. In addition, because the effects of climate change are likely to differ considerably by location and resource, the need for specialized regulation tailored to particular conditions rather than a uniform standard or cap is substantially greater in the adaptation context. Concurrently, because anthropogenic climate change is transforming ecological processes, accelerating change, and spurring ecological migration, it increases the interaction of jurisdictions and the extent of regulatory overlap among government authorities.[85] This ecological change and consequent increased blurring and shifting of regulatory problems makes the argument for primarily localized control less persuasive. Indeed, at least one scholar has

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80. *See* Kirsten H. Engel, *Harnessing the Benefits of Dynamic Federalism in Environmental Law*, 56 EMORY L.J. 159, 178–79 (2006).

81. *See, e.g.*, *id.*; *see also* Snyder & Binder, *supra* note 68, at 252 ("Certain redundancies that result from an overlapping cooperative federalism approach are actually desirable.").

82. *See* Adelman & Engel, *supra* note 77, at 285.

83. *See* Adelman & Engel, *supra* note 76, at 1846–49 (discussing the benefits of California imposing auto emission standards in excess of what the federal Clean Air Act requires); Carlson, *supra* note 68, at 310–11 (same); Engel, *supra* note 80, at 159–62 (same).

84. *See supra* notes 17–24 and accompanying text.

85. *See* Alejandro E. Camacho, *Assisted Migration: Redefining Nature and Natural Resource Law Under Climate Change*, 27 YALE J. ON REG. 171, 208–10 (2010). For example, regulatory conflict is likely to occur if the Bureau of Land Management ("BLM"), consistent with its stated goals that prioritize consumptive economic land uses, decides to introduce a nonnative species that is well adapted to new climate conditions onto BLM lands, and that species spreads to a nearby federal wildlife refuge and causes harm to other species in contravention with U.S. Fish and Wildlife Service ("FWS") authority over federal wildlife refuges. *See id.*

promoted a reliance on overlapping regulatory authority in the context of adaptation.[86]

In short, climate change makes it even more difficult to identify a single appropriate regulatory scale for managing natural resources. Yet, this is precisely what makes an overlapping, decentralized governance model such a great match for natural resources law and climate change adaptation. Designed correctly, a federal natural resources system can help encourage innovation, account for both environmental and regulatory diversity, and promote more effective resource management by providing the opportunity for inter-jurisdictional information sharing. However, in general, existing U.S. natural resources governance is poorly designed to promote these potential benefits.

c. Problems with Regional Collaboration Proposals

To best accommodate the competing objectives of promoting innovation and learning while minimizing inefficient and ineffectual resource management, the most common response has been to create venues for promoting collaborative decision making. Rather than consolidation or additional centralized agency oversight, many scholars and agencies have backed the creation of networks for interagency collaboration and coordination,[87] often focused around particular ecosystems or landscapes.[88] Such proposals seek to minimize the negative features of decentralized regulatory authority by providing additional opportunities for communication and synchronization rather than through consolidating decision making authority. As a result, regional regulatory networks are now quite common in American natural resources management.[89] In fact, the primary federal initiative directed at studying

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86. *See* J.B. Ruhl, *Climate Change Adaptation and the Structural Transformation of Environmental Law*, 40 ENVTL. L. 363, 429 (2010) ("[W]hile it may appear inefficient to have several agencies at different scales working away on some mutual adaptation policy problem, the built-in redundancy of Dynamic Federalism can provide significant benefits. It gives the overall system of governance more rather than less policy space, which surely will be needed for climate change adaptation.").

87. *See, e.g.*, EUGENE BARDACH, GETTING AGENCIES TO WORK TOGETHER: THE PRACTICE AND THEORY OF MANAGERIAL CRAFTSMANSHIP 1–18 (1998); U.S. CLIMATE CHANGE SCI. PROGRAM & THE SUBCOMM. ON GLOBAL CHANGE RESEARCH, PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS AND RESOURCES 7–60 (2008), *available at* http://www.climatescience.gov/ Library/sap/sap4-4/final-report/sap4-4-final-report-all.pdf; Ruhl & Salzman, *supra* note 53, at 112–16.

88. *See, e.g.*, R. Edward Grumbine, *What Is Ecosystem Management?*, 8 CONSERVATION BIOLOGY 27, 29–31 (1994); Karkkainen, *supra* note 46, at 1439–42.

89. *See* Camacho, *supra* note 24, at 26–27.

and considering how to plan for the effects of climate change relies on a collaborative federal agency network.[90]

However, these proposals do not really address the core challenge of reducing and managing uncertainty. Unfortunately, most inter-jurisdictional government assemblages fail to sufficiently commit to promoting information sharing, providing opportunities for collaboration, or otherwise increasing opportunities for inter-governmental learning. Resource managers have limited information and tools for obtaining, organizing, and accessing information on their own office's decisions[91] and typically lack access to the data or strategies of other regional offices or agencies.[92] Though regional collaborations could be set up to provide such an infrastructure, they rarely focus on doing so. Instead, such programs merely add more layers of regulation to the already considerable fragmentation in natural resources management.[93] As a result, even regulators interested in developing adaptation strategies have difficulty obtaining useful information about the collective management experience regarding the performance of adopted management strategies.[94] When combined with the considerable uncertainty that exists regarding possible climate change effects, the information gaps that exist about the efficacy of past strategies leave regulators with limited capacity to manage uncertainty that is necessary for effective climate change adaptation.[95] Natural resources thus continue to remain susceptible to regulatory procrastination.

II. THE WEAK ADAPTIVE CAPACITY OF NATURAL RESOURCE GOALS

Many natural resources laws are also poorly suited to foster effective adaptation because they prioritize preservationism and minimizing human interaction with natural systems. This understanding is incongruent with the dynamic nature of ecosystems and the pervasiveness of the human-nature relationship, particularly in light of modern anthropogenic climate

90. *See* INTERAGENCY TASK FORCE REPORT, *supra* note 60, at 9. The Interagency Climate Change Adaptation Task Force, which includes over twenty federal government agencies, was created to provide proposals on adaptation planning for federal agencies. The task force serves as a venue for federal agencies, working with state and local authorities, to communicate, brainstorm, and collaboratively develop recommendations for the president on potential federal adaptation strategies. *Id.*

91. *See* Adler, *supra* note 75, at 165–66.

92. *See* Camacho, *supra* note 28, at 341 (noting that this is true of FWS employees negotiating HCPs, and that the problem is exacerbated by high staff turnover at FWS); Karkkainen, *supra* note 34, at 496.

93. *See* Camacho, *supra* note 24, at 26–28.

94. *See id.* at 29.

95. *See* Robin Kundis Craig, *"Stationarity is Dead"—Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 HARV. ENVTL. L. REV. 9, 58–60 (2010).

changes. Future climatic changes are likely to make the discrepancy between these legal goals and the dynamic, integrated natural environment increasingly apparent. In fact, climate change is likely to set minimal management and preservationist goals against each other.

A. A Focus on Shielding Nature and Historical Preservation

Much of natural resources law and policy is grounded in preservation and restoration to a historical baseline.[96] Many existing legal goals focus on promoting ecological inertia or restoration of an ecological system to an earlier state.[97] Many natural resource managers also regularly focus on promoting the preservation or restoration of existing or past ecological conditions, typically to a pre-European settlement baseline.[98]

The less prevalent version of this preservationist approach stresses shielding nature from active human intervention, thus keeping ecological systems in (or returning them to) a "natural" state.[99] Such an approach is epitomized by the federal Wilderness Act, which focuses on protecting areas designated as "wilderness," defined as:

> an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain[;] . . . an area of underdeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable . . . .[100]

Such areas are not principally protected for their ecological value or even to preserve the historical condition of the ecosystem. The Act requires

96. *See* Camacho, *supra* note 85, at 205–07; *see also* NAT'L PARK SERV., MANAGEMENT POLICIES § 4.1 (2006) [hereinafter NPS MANAGEMENT POLICIES], *available at* http://www.fws.gov/policy/manuals/ ("[P]reserving park resources and values unimpaired is the core or primary responsibility of NPS managers."); U.S. FISH & WILDLIFE SERV., SERVICE MANUAL 601 FW 3.15C [hereinafter FWS SERVICE MANUAL], *available at* http://www.fws.gov/policy/601fw3.html ("We do not allow refuge uses or management practices that result in the maintenance of non-native plant communities unless we determine there is no feasible alternative . . . . ").

97. *See, e.g.*, National Park Service Organic Act, 16 U.S.C. § 1 (2006) (stating a purpose of "conserv[ing] the scenery and the natural and historic objects and the wild life therein . . . unimpaired for the enjoyment of future generations.").

98. *See* A. Starker Leopold et al., *Wildlife Management in the National Parks*, *in* TRANSACTIONS OF THE TWENTY-EIGHTH NORTH AMERICAN WILDLIFE AND NATURAL RESOURCES CONFERENCE 29, 29–44 (James B. Trefethen ed., 1963).

99. *See, e.g.*, BILL MCKIBBEN, THE END OF NATURE 47 (2006) (noting the inherent human desire to maintain "pristine places, places substantially *unaltered* by man").

100. 16 U.S.C. § 1131(c) (2006).

federal agencies to manage such areas "in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, [and] the preservation of their wilderness character . . . ."[101] Accordingly, though wilderness areas may "contain ecological, geological, or other features of scientific, educational, scenic, or historical value,"[102] they are above all protected because they are wild and minimally influenced or disturbed by human activity.[103] Preservation of the wild character of certain lands has intrinsic value[104] and/or provides humans spiritual,[105] psychic,[106] scientific,[107] economic,[108] and existence[109] benefits. This perspective relies on a human-nature dualism[110] in which wild natural landscapes are accepted as normatively good[111] in contrast with the interference of active human management.[112]

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101. § 1131(a); *see also* § 1131(c) (stating a wilderness area must be "protected and managed so as to preserve its natural conditions . . . ."); *cf.* Wilderness Soc'y v. U.S. Fish & Wildlife Serv., 353 F.3d 1051, 1067 (9th Cir. 2003) (en banc) ("[T]he Wilderness Act requires that the lands and waters duly designated as wilderness must be left untouched, untrammeled, and unaltered by commerce."); High Sierra Hikers Ass'n v. U.S. Forest Serv., 436 F. Supp. 2d 1117, 1133 (E.D. Cal. 2006) (concluding that manmade river structures did not "further the goals of the Wilderness Act"); Sierra Club v. Lyng, 662 F. Supp. 40, 42–43 (D.D.C. 1987) (placing the burden of proof on the secretary of agriculture when enacting measures that "contravene wilderness values guaranteed by the Wilderness Act").

102. § 1131(c).

103. *See, e.g.*, LINDA H. GRABER, WILDERNESS AS SACRED SPACE 11 (1976); JACK TURNER, THE ABSTRACT WILD 120 (1996).

104. *See, e.g.*, Reed Noss, *Wilderness Recovery*, *in* THE GREAT NEW WILDERNESS DEBATE 521, 525–26 (J. Baird Callicott & Michael P. Nelson eds., 1998) ("Some people, for reasons quite beyond the rational, believe that huge, wild areas are valuable for their own sake.").

105. *See, e.g.*, RODERICK FRAZIER NASH, WILDERNESS & THE AMERICAN MIND 157 (4th ed. 2001) ("[A]t a time when the force of religion seemed vitiated by the new scientism on the one hand and social conflict on the other, wilderness acquired special significance as a resuscitator of faith."); John Copeland Nagle, *The Spiritual Values of Wilderness*, 35 ENVTL. L. 955, 979–84 (2005) (documenting the substantial weight given in congressional hearings on the Wilderness Act to the spiritual value of wilderness).

106. *See* William Cronon, *The Trouble with Wilderness, or, Getting Back to the Wrong Nature*, *in* THE GREAT NEW WILDERNESS DEBATE, *supra* note 104, at 471, 483.

107. CHRIS MASER, THE REDESIGNED FOREST 174 (1988) (asserting that untouched nature provides ecologists an invaluable template to learn from, for the restoration of damaged ecosystems).

108. *See* Jan G. Laitos & Rachael B. Gamble, *The Problem with Wilderness*, 32 HARV. ENVTL. L. REV. 503, 511–12 (2008) ("[L]ow-impact recreationists who want to access wilderness account for some of the $300 billion in annual retail sales for gear, food, lodging, entertainment, and transportation associated with recreating in America's outdoors. Non-motorized outdoor recreation pumps $730 billion into the United States economy annually, and supports about 6.5 million jobs.").

109. *See, e.g.*, John V. Krutilla, *Conservation Reconsidered*, 57 AM. ECON. REV. 777, 781 (1967); Laitos & Gamble, *supra* note 108, at 510.

110. *See* MCKIBBEN, *supra* note 99, at 48 (describing dualism and the idea of nature as "the separate and wild province, the world apart from man").

111. *See* HOLMES ROLSTON, ENVIRONMENTAL ETHICS: DUTIES TO AND VALUES IN THE

The more pervasive version of preservation in natural resources law is essentially antiquarian, emphasizing the minimization of the nonnative and the preservation or restoration of preexisting ecological communities with reference to a historical benchmark.[113] Many modern conservation and public land laws and management policies are premised on protecting biota that preexisted European settlement and inhibiting those that did not.[114] For example, virtually all state and federal invasive species laws, regulations, and agency policies that regulate the intentional and inadvertent movement of species are premised on the distinction between native and nonnative.[115] "Invasive" under federal law includes as a necessary prerequisite that the species is nonnative,[116] so that destructive native species are not considered invasive.[117] Likewise, on virtually all federal lands there is a strong presumption in favor of avoiding, limiting, and removing exotic species.[118]

NATURAL WORLD 238 (1988) ("If we come to a landscape on its own terms, sensitive to its integrity, wild is always a positive predicate."); Michael McCloskey, *Changing Views of What the Wilderness System Is All About*, 76 DENV. U. L. REV. 369, 375 (1999).

112. *See* ROBERT ELLIOT, FAKING NATURE: THE ETHICS OF ENVIRONMENTAL RESTORATION 79 (1997); Eric Katz, *The Ethical Significance of Human Intervention in Nature*, 9 RESTORATION & MGMT. NOTES 90, 92 (1991) ("Depending on the adequacy of our technology, . . . restored and redesigned natural areas will appear more or less natural, but they will never be natural—they will be anthropocentrically designed human artifacts.").

113. *See* Camacho, *supra* note 85, at 231.

114. *Id.* at 218.

115. *See, e.g.*, NPS MANAGEMENT POLICIES, *supra* 96, § 4.4.1.3; FWS SERVICE MANUAL, *supra* note 96, at 701 FW 1.4B (classifying indigenous species as those "[o]riginating in and being produced, growing, or living in a particular region or environment").

116. Proclamation No. 13,112, 64 Fed. Reg. 6183, 6183 (Feb. 3, 1999); NAT'L INVASIVE SPECIES COUNCIL, MANAGEMENT PLAN: MEETING THE INVASIVE SPECIES CHALLENGE 2 (2001), *available at* http://www.invasivespeciesinfo.gov/docs/council/mpfinal.pdf (characterizing invasive as "a species that is . . . non-native (or alien) to the ecosystem under consideration and . . . whose introduction causes or is likely to cause economic or environmental harm or harm to human[, animal, or plant] health"); U.S. DEP'T OF AGRIC., NATIONAL STRATEGY AND IMPLEMENTATION PLAN FOR INVASIVE SPECIES MANAGEMENT 1 (Lynn Starr ed., 2004), *available at* http://www.fs.fed.us/invasivespecies/documents/Final_National_Strategy_100804.pdf.

117. *See, e.g.*, NAT'L INVASIVE SPECIES COUNCIL, INVASIVE SPECIES DEFINITION CLARIFICATION AND GUIDANCE WHITE PAPER 3 (2006), *available at* http://www.doi.gov/NISC/global/ISAC/ISAC_documents/ISAC%20Definititions%20White%20Paper%20%20-%20FINAL%20VERSION.pdf ("While non-migratory populations can cause problems, they are not considered an *invasive species* because they are native.").

118. *See, e.g.*, NPS MANAGEMENT POLICIES, *supra* note 96, § 4.4.4.2 ("All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed—up to and including eradication."); U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MANAGEMENT MANUAL § 1745.06(A) (1992) [hereinafter BLM MANUAL] (stating that native species shall be used in any introduction, transplant, restocking, and reestablishment activity unless various stringent requirements are met); *id.* § 1745.06(H) ("In designated wilderness areas, . . . [e]xotics shall not be introduced."); U.S. FISH & WILDLIFE SERV., REFUGE MANUAL pt. 7, § 8.1 (1982) [hereinafter FWS REFUGE SYSTEM MANUAL] ("The continued existence, or management of exotic plants and animals on refuge lands will be permitted only if: [i] An exotic species has

To varying degrees, most federal conservation and land management laws and agencies also emphasize protecting preexisting biotic communities. The National Park Service Organic Act requires the National Park Service ("NPS") "to conserve the scenery and the natural and historic objects and the wild life therein . . . as will leave them unimpaired for the enjoyment of future generations."[119] This preservation goal mandates that the NPS cannot approve an action if it could lead to the impairment of any preexisting resources or values of a national park.[120] Similarly, the federal Endangered Species Act is predominantly concerned with only protecting native endangered or threatened species within their historical range;[121] other implementing regulations or policies for protecting rare species focus on native species as well.[122] In managing federal wildlife refuges under the National Wildlife Refuge System Improvement Act ("NWRSIA"),[123] the U.S. Fish and Wildlife Service ("FWS") emphasizes preserving and restoring native species' populations and habitats[124] to "historic

become established and its elimination, while desirable, is no longer practicable, or [ii] An exotic species has become established and maintained on a non-augmented basis for at least 25 years and does not conflict with refuge objectives."); FWS SERVICE MANUAL, *supra* note 96, at 601 FW 3.15(C) ("We do not allow refuge uses or management practices that result in the maintenance of non-native plant communities unless we determine there is no feasible alternative."); U.S. FOREST SERV., FOREST SERVICE MANUAL § 2323.34c(1) (2007) [hereinafter USFS MANUAL], *available at* http://www.fs.fed.us/im/directives/ dughtml/fsm.html ("Do not stock exotic species of fish in wilderness."); *id.* § 2323.33a.

119. 16 U.S.C. § 1 (2006).

120. NPS MANAGEMENT POLICIES, *supra* note 96, § 4.1 ("[P]reserving park resources and values unimpaired is the core or primary responsibility of NPS managers."); *see also id.* § 4.4.2.2 ("Service will strive to restore extirpated native plant and animal species."); *id.* § 4.4.1 ("The National Park Service will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems."); *id.* § 4.4.1.2 ("The Service will strive to protect the full range of genetic types (genotypes) of native plant and animal populations in the parks by perpetuating natural evolutionary processes and minimizing human interference with evolving genetic diversity."); *id.* § 4.4.2.5 ("In altered plant communities managed for a specified purpose, plantings will consist of species that are native to the park or that are historically appropriate for the period or event commemorated.").

121. A number of state endangered species laws also refuse to extend protection under their endangered species acts to nonnative species. *See* ARIZ. REV. STAT. § 17-296 (LexisNexis 2008); FLA. STAT. § 379.2291 (2011); NEV. REV. STAT. § 503.584(2)(a) (2010); N.C. GEN. STAT. § 113-331(2) (2009).

122. *See, e.g.*, NPS MANAGEMENT POLICIES, *supra* note 96, § 4.4.2.3 ("The Service will survey for, protect, and strive to recover all species native to national park system units that are listed under the [ESA]. . . . [T]he Service will inventory other native species that are of special management concern to parks . . . and will manage them to maintain their natural distribution and abundance.").

123. 16 U.S.C. § 668dd (2006).

124. *See, e.g.*, FWS REFUGE SYSTEM MANUAL, *supra* note 118, at pt. 7, § 8.1; *id.* at pt. 7, § 12.2.; FWS SERVICE MANUAL, *supra* note 96, at 601 FW 3.10B(1) ("The System's focus is on native species and natural communities such as those found under historic conditions."); *id.* at 601 FW 1.9A ("The overarching goal of the Refuge System is to conserve a diversity of fish,

conditions."[125] Management regulations implementing the Wilderness Act promote protecting or restoring native populations and natural processes.[126] Even though lands managed by the Bureau of Land Management ("BLM") and the U.S. Forest Service were initially established to be managed for use rather than preservation, they nonetheless consider their central conservation objective to be sustaining and enhancing native ecological systems and species.[127]

Indeed, the primary strategy of natural resources management—the reserve model of conservation[128]—is largely premised on preserving preexisting resources in certain areas and keeping or removing all others.[129] By tying resource conservation to such a historical baseline, this preservationist approach to natural resources management treats nature as not only relatively fixed but also context-specific.[130]

B. Climate Change and the End of Preservation

Though there may be a variety of shortcomings with existing natural resources law in the United States, it nonetheless has been at least

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wildlife, and plants and their habitats . . . with a focus on native species.").

125. FWS SERVICE MANUAL, *supra* note 96, at 601 FW 3.12; *id.* at 601 FW 3.6D (defining historic conditions as "[c]omposition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human related changes to the landscape").

126. NPS MANAGEMENT POLICIES, *supra* note 96, § 6.3.7; BLM MANUAL, *supra* note 118, § 1745.06(H).

127. *See* 36 C.F.R. § 219.10(b) (2009) ("The overall goal of the ecological element of sustainability is to provide a framework to contribute to sustaining native ecological systems . . . ."); BLM MANUAL, *supra* note 118, § 1745.02 (stating as the first two objectives of the BLM's policy on introductions: "(1) Ensure that management of native, naturalized and exotic species enhances, restores, and does not reduce the biological and genetic diversity of natural ecosystems" and "(2) Ensure that the introduction of exotic species is ecologically sound and will not adversely impact natural ecosystems"); USFS MANUAL, *supra* note 118, § 2070.2 (seeking to promote the "use of native plant materials in revegetation, rehabilitation, and restoration of both aquatic and terrestrial ecosystems").

128. *See, e.g.*, Terry L. Erwin, *An Evolutionary Basis for Conservation Strategies*, 253 SCIENCE 750, 750 (1991) ("National parks, wildlife refuges, biosphere reserves, military reserves, Indian reservations, and other forms of legally protected areas have been established for aesthetic, political, or practical purposes in the last 150 years."); C.R. Margules & R.L. Pressey, *Systematic Conservation Planning*, 405 NATURE 243, 243 (2000); Rahel et al., *supra* note 12, at 552.

129. *Cf.* Holly Doremus, *The Endangered Species Act: Static Law Meets Dynamic World*, 32 WASH. U. J.L. & POL'Y 175, 205–06 (2010) (stating that traditional conservation strategies, including preserves, "assume[] that what nature needs most is for people to leave it alone").

130. *See, e.g.*, YI-FU TUAN, SPACE AND PLACE: THE PERSPECTIVE OF EXPERIENCE 6 (1977); Holmes Rolston III, *Environmental Ethics: Values in and Duties to the Natural World*, *in* ECOLOGY, ECONOMICS, ETHICS: THE BROKEN CIRCLE 73, 86 (F. Herbert Bormann & Stephen R. Kellert eds., 1991) ("A species is what it is where it is."); Daniel R. Williams et al., *Beyond the Commodity Metaphor: Examining Emotional and Symbolic Attachment to Place*, 14 LEISURE SCI. 29, 31 (1992) (examining sense of place and place attachment to wilderness areas).

moderately effective at maintaining natural resources that under the reserve model have been set aside. This is in large part because, until recently, ecological change has been relatively slow since the onset of modern natural resources law. However, the onset of global anthropogenic climate change makes it increasingly apparent that the human-nature dualist and preservationist goals of natural resources law are incongruent with the interconnectedness of human and natural systems and existing knowledge about ecological dynamics. Climate change thus reveals the limits of both of these models of American natural resources law and accelerates the need to depart from them.

1. The Questionable Benefit of Avoiding Human Management

First, climate change makes it quite apparent that any attempt to protect nature as untouched is belated and artificial. Of course, many have argued that the goal of quarantining nature from humanity is an illusory one[131] in light of the historical extent of human effects on what are considered natural ecological systems.[132] Yet, human influence on ecological systems is even more pervasive as a result of anthropogenic climate change in addition to other human-induced stressors.[133] If maintaining the human-nature dichotomy embodied by laws like the Wilderness Act was ever an attainable goal,[134] it certainly is not now.[135]

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131. MATHIS WACKERNAGEL & WILLIAM REES, OUR ECOLOGICAL FOOTPRINT: REDUCING HUMAN IMPACT ON THE EARTH 4 (1996) ("[T]he human enterprise cannot be separated from the natural world even in our minds because there is no such separation in nature."); J.B. Ruhl, *The Pardy-Ruhl Dialogue on Ecosystem Management, Part IV: Narrowing and Sharpening the Questions*, 24 PACE ENVTL. L. REV. 25, 30–31 (2007) (arguing that "naturalness" and the "natural/unnatural dichotomy" are human constructs and subjective).

132. *See* STEPHEN BUDIANSKY, NATURE'S KEEPERS: THE NEW SCIENCE OF NATURE MANAGEMENT 103–11 (1995) (detailing how repeated burnings by pre-Columbian human populations shaped what we now consider to be American flora and fauna); William Tucker, *Is Nature Too Good for Us?*, *in* TAKING SIDES: CLASHING VIEWS ON CONTROVERSIAL ENVIRONMENTAL ISSUES 34, 42 (Theodore D. Goldfarb ed., 4th ed. 1991) ("Wilderness today means the land *after* the Indians have been cleared away but *before* the settlers have arrived.").

133. *See* DANIEL B. BOTKIN, DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE TWENTY-FIRST CENTURY 194 (1990) ("[T]here is no longer any part of the Earth that is untouched by our actions in some way . . . ."); Robert R.M. Verchick, *Steinbeck's Holism: Science, Literature, and Environmental Law*, 22 STAN. ENVTL. L.J. 3, 16 (2003) ("[E]very ecological system on the planet has been touched by human conduct, directly or indirectly, whether by genetic manipulation, air and water pollution, climate change, or farming."); Jonathan Baert Wiener, *Beyond the Balance of Nature*, 7 DUKE ENVTL. L. & POL'Y F. 1, 12 (1996).

134. *But see* G. Stanley Kane, *Restoration or Preservation? Reflections on a Clash of Environmental Philosophies*, *in* BEYOND PRESERVATION: RESTORING AND INVENTING LANDSCAPES 69, 70 (A. Dwight Baldwin, Jr. et al. eds., 1994) (asserting that because "humans are systematically excluded" from wilderness areas, wilderness areas are "the most astonishingly unnatural places on earth").

135. *See, e.g.*, Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on*

At this point, virtually *any* adaptation strategy would have a considerable effect on ecological systems. In fact, given the extensive already-present human-induced barriers to the migration of biota to adjust to climate change,[136] even the choice to not act to adapt to the effects of climate change would substantially affect ecological systems. As a result, choosing not to affect ecosystems may simply be impossible. Furthermore, climate change raises the ecological costs of relying only on passive management with the goal of keeping less disturbed areas "wild." As reserved areas progressively decline and degrade from the combined effects of anthropogenic climatic change or other human activities, any activity to ameliorate such effects would increasingly obscure any human-nature divide. To maintain the "wildness" goal, managers would have to accept substantially impaired ecosystems as climatic changes ravage existing reserves. Of course, the election to not actively manage does not mean an ecosystem will be undisturbed by human activity—global climate change ensures this will not be so. As a result, climate change more fundamentally calls into question what the benefit is of isolating a land reserve and barring its active management to maintain or increase ecological function.

2. The Increasing Infeasibility of Preservation

Of course, rather than doing nothing, another option for dealing with the effects of climate change might be to actively manage to ensure that ecological conditions on the reserved land do not change substantially from current and/or past conditions. Such an objective would be consistent with the other preservationist strand of natural resources law that seeks to maintain ecological conditions at a historical baseline.[137] However, such strategies would be fundamentally at odds with existing knowledge about ecological dynamics, particularly in light of the swift and substantial effects of global climate change.

American Law: An Introduction, 69 CHI.-KENT L. REV. 847, 870 (1994) ("The accelerating interaction between humans and the natural environment makes it impossible to return to an ideal state of nature.").

136. *See* Malcolm L. Hunter, Jr., *The Biological Landscape*, *in* CREATING A FORESTRY FOR THE 21ST CENTURY: THE SCIENCE OF ECOSYSTEM MANAGEMENT 57, 62 (Kathryn A. Kohm & Jerry F. Franklin eds., 1997) (explaining how highways and fences can impede dispersal of even large animals); Brian Lavendel, *Ecological Restoration in the Face of Global Climate Change: Obstacles and Initiatives*, 21 ECOLOGICAL RESTORATION 199, 202 (2003) ("Current habitat fragmentation patterns and human barriers may prevent range shifts."); *see also* Emma Marris, *Moving on Assisted Migration*, 2 NATURE REP. 112, 113 (2008), *available at* http://www.nature.com/climate/2008/0809/pdf/climate.2008.86.pdf ("Humans have dominated the landscape to such an extent that natural dispersal cannot take place in many areas.").

137. *See supra* Part II.A.

The historical preservation goal in existing natural resources law largely reflects an antiquated equilibrium model of ecology that stresses the natural stability of ecosystems.[138] However, this model has been widely discredited in ecological science as failing to reflect the complexity and dynamism of ecosystems.[139] Accordingly, the continued regulatory focus on maintaining or restoring ecosystem constituents for the principal reason that they previously existed at the site attempts to impose stasis on ecological communities that otherwise would change over time. Any attempt to preserve or restore to a historical baseline based on the notion that doing so somehow serves to conserve ecosystems in a single fixed and objectively natural state is incompatible with prevailing ecological knowledge. The embedded division between native and nonnative species in laws, regulations, and management policies on invasive species, public lands, and endangered species simply reflects a myopic view of ecology and evolution.

Despite being based on an erroneous understanding of ecological stasis, before climate change began, natural resources law and management were nonetheless able to reasonably approximate historical conditions. To be sure, defining an original baseline when ecosystems are perpetually in flux is difficult if not impossible.[140] Yet until recently most ecological change fell within a fairly limited range of variability.[141] In light of the convulsive effects of climate change, however, accomplishing historical preservation or restoration goals becomes at best increasingly costly and perhaps even impossible. Many ecologists have concluded that climate change is likely to stress ecosystems at a rate and to an extent that is outside the range of historical variability, pressuring biotic assemblages and communities to transform in fundamental ways.[142]

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138. *See* Reed F. Noss, *Some Principles of Conservation Biology, as They Apply to Environmental Law*, 69 CHI.-KENT L. REV. 893, 893 (1994).

139. *See* A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOY. L.A. L. REV. 1121, 1122–23 (1994) ("[T]he equilibrium paradigm has been rejected in ecology and replaced with a complex, stochastic nonequilibrium one.").

140. *See* Donald Worster, *Nature and the Disorder of History*, *in* REINVENTING NATURE 65, 143 (Michael E. Soulé & Gary Lease eds., 1995) ("[A]ny serious attempt to define the original state of a community or ecosystem leads to a logical and scientific maze.").

141. The "stationarity" model that is dominant in modern ecology and gaining momentum in natural resources management is still premised on "the idea that natural systems fluctuate within an unchanging envelope of variability." P.C.D. Milly et al., *Stationarity Is Dead: Whither Water Management?*, 319 SCIENCE 573, 573 (2008). Though this model may recognize that ecosystem conditions are in flux, it depends on the assumption that any variability in ecosystems is bounded. *See* Ruhl, *supra* note 86, at 393.

142. *See, e.g.*, Parmesan, *supra* note 9, at 643–44 (discussing phenological changes due to climate change); Parry et al., *supra* note 9, at 10–12 (projecting with very high confidence increased harm to coastal and freshwater resources); Rahel et al., *supra* note 12, at 557 ("Climate

In such circumstances, climate change will require increasingly active human management to maintain preservation goals that will be progressively more costly and perhaps impossible to meet for some ecosystems. In fact, reserved lands may become inhospitable to and fundamentally incompatible with the very resources they were established to protect.[143] At the same time, the value of preserving an ecosystem in its historical condition becomes increasingly questionable. Historical ecological preservation or restoration still may provide important scientific, educational, and cultural benefits in particular cases.[144] However, such value will have to be weighed against the potential loss of ecological function that comes with (1) actively cultivating resources that might be increasingly incompatible with climatic conditions and (2) actively preventing the arrival of other biological resources that otherwise would immigrate to the reserve. Climate change ensures that in many cases there will be escalating ecological and other costs, and diminishing gains from engaging in ecosystem preservation and restoration.

Finally, by making ecological preservation and restoration increasingly an active management enterprise, global anthropogenic climate change pits the historical preservation goal against the goal of avoiding human management of ecological systems. In the past, such goals may have been in tension with each other, as at least passive management would be needed to keep preserved areas as they are. Yet at least the reserve model of cordoning off and isolating resource lands was theoretically congruent with both keeping nature as it is and leaving it alone. In the context of climate change, resource managers may choose to not manage ecological systems, leaving reserved areas to rearrange as climatic changes occur. Alternatively, managers could choose to actively manage the reserve to ensure that it maintains similar ecological conditions as in the past. However, they will not be able to do both.[145]

In fact, as global climatic changes exert increasing pressure on biota in a wide range of ecosystems to adapt, the primary goal should neither be

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changes . . . may cause environmental conditions to exceed the historic range of variability to which species are adapted."); Ryan et al., *supra* note 11, at 96–97 (projecting greater disturbance to forests from fire, pestilence, and disease).

143. *See* Camacho, *supra* note 85, at 247.

144. *See, e.g.*, Stephen T. Jackson & Richard J. Hobbs, *Ecological Restoration in the Light of Ecological History*, 325 SCIENCE 567, 568 (2009) (asserting that even with global climate change, historical restoration will provide useful data about ecosystems and the effectiveness of management responses to disruptions).

145. *Cf.* Cronon, *supra* note 106, at 485 ("To the extent that biological diversity (indeed, even wilderness itself) is likely to survive in the future only by the most vigilant and self-conscious management of the ecosystems that sustain it, the ideology of wilderness is potentially in direct conflict with the very thing it encourages us to protect.").

preventing natural resources management strategies from affecting natural systems nor avoiding a departure of ecological conditions from a historical norm. At best, both avoiding human management and actively managing ecosystems to maintain historical conditions would be increasingly costly, yet provide diminishing and questionable benefits given projected climate changes. Consequently, neither shielding nature from human interference nor the active management of reserve lands to maintain historical conditions are likely to be viable goals for adapting natural resources to the effects of climate change. Rather, natural resources management must be principally directed at anticipating future climatic conditions, developing mechanisms for assessing the value of potential ecological components and processes, weighing tradeoffs between such potential components and processes, and minimizing the detrimental and maximizing the beneficial consequences from management strategies and other human activities on natural systems.[146]

III. A SYNERGISTIC PROMOTION OF STASIS

Though both existing management processes and the objectives of natural resources law in the United States provide distinct limitations on the capacity of natural resources management to adapt to the effects of climate change, they are interconnected and mutually reinforcing in a number of ways. Of course, the central theme that links the static view of nature enshrined in natural resources law and the prevalent rigid model of regulatory decision making together is that both are premised on promoting stasis and stability.[147] Existing natural resources law is based on static or fixed models of nature and decision making—both the ends to which natural resources should be managed and the means through which government institutions and the public more generally learn and decide. In general, administrative law continues to task natural resource agencies with providing front-end, comprehensive, and conclusive strategies for managing what are typically very complex systems and problems about which there regularly is incomplete information.[148]

This model based on stasis is the result of a longstanding and pervasive emphasis on an understanding of law as an attempt to provide certainty and stability through legal rules.[149] Indeed, courts and Congress

146. Wiener, *supra* note 133, at 14 ("Change is inevitable, and what matters is not the false choice of preservation versus change, but the real choice of which changes are benign and which are adverse.").

147. *See supra* Part II.A.

148. *See* Camacho, *supra* note 24, at 37–38.

149. *See, e.g.*, LON L. FULLER, THE MORALITY OF LAW 39 (1977) (identifying "introducing such frequent changes in the rules that the subject cannot orient his action by them" as one of the

have incorporated this emphasis on certainty into the conventional administrative law rulemaking process, which only allows subsequent adjustments to adopted rules through engaging in the lengthy and costly rulemaking process yet again.[150] Such a step at most, occurs sporadically over a rule's lifetime. To be sure, over the past few decades proponents of adaptive management have increasingly emphasized a more nuanced approach that encourages agencies to constantly review, reevaluate, and, if necessary, change their decisions in order to adapt to changing circumstances or improve ineffective policy.[151] However, a fundamental and yet unresolved tension remains between the competing goals of providing certainty through front-end decision making and the need for provisionalism in light of limited information and changes in circumstances that inevitably arise in the regulatory process.[152] Though there are encouraging signs that some courts recognize the need for provisionalism and seek to accommodate the need for adaptive management, courts continue to reject elements of adaptive management plans that allow subsequent adjustment when not expressly allowed under enabling statutes

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eight major ways that a legal system may be misused); B.E. WITKIN, CALIFORNIA PROCEDURE, at Appeal § 481, at 541 (5th ed. 2008) (noting that stare decisis "is based on the assumption that certainty, predictability, and stability in the law are the major objectives of the legal system; i.e., that parties should be able to regulate their conduct and enter into relationships with reasonable assurance of the governing rules of law"); Richard H. Fallon, Jr., *"The Rule of Law" as a Concept in Constitutional Discourse*, 97 COLUM. L. REV. 1, 8 (1997) (identifying "stability" as the third of five elements that constitute the Rule of Law); Joseph Raz, *The Rule of Law and Its Virtue*, *in* THE AUTHORITY OF LAW: ESSAYS ON LAW AND MORALITY 214–15 (1979) ("*Laws should be relatively stable*. They should not be changed too often. If they are frequently changed people will find it difficult to find out what the law is at any given moment and will be constantly in fear that the law has been changed since they last learnt what it was."); Antonin Scalia, *The Rule of Law as a Law of Rules*, 56 U. CHI. L. REV. 1175, 1179 (1989).

150. *See* Administrative Procedure Act, 5 U.S.C. § 553 (2006); Paralyzed Veterans of Am. v. D.C. Arena L.P., 117 F.3d 579, 586 (D.C. Cir. 1997) ("To allow an agency to make a fundamental change in its interpretation of a substantive regulation without notice and comment obviously would undermine [the] APA requirements."); Nat'l Family Planning & Reprod. Health Ass'n, Inc. v. Sullivan, 979 F.2d 227, 241 (D.C. Cir. 1992) (holding that agencies cannot create new constructions of rules that substantially alter their meaning without undergoing notice and comment rulemaking).

151. *See* J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L. REV. 424, 428–29, 438 (2010) ("The legal view of a resource management plan is that it comprehensively evaluates all rational considerations at once and then flips a toggle switch; the adaptive management approach twiddles the dial as information trickles in.").

152. *See id*. at 443–44. Ruhl and Fischman noted that as of May 2010 there were thirty-one federal court decisions struggling with the legality of adaptive management, and that the government had lost more than half of them. *Id*. at 444–45. However, at least some courts are not categorically rejecting adaptive management approaches; in particular, adaptive management programs that rely on large-scale plans that tie site-specific adaptive components to data in larger cumulative studies and contain their adaptive elements within the outer bounds of the legally required substantive management criteria have been successful. *See id*. at 445.

or underlying regulations.[153] Furthermore, because of budget constraints, lack of accountability, and other disincentives, government officials often have limited interest in the persistent monitoring and subsequent adjustment of decisions in furtherance of program goals that learning requires.[154] In short, existing natural resources management and the administrative law that governs it remain premised on a fairly static, front-end model of decision making.

Yet as detailed earlier, existing scientific knowledge makes quite evident that natural systems are far from static,[155] and the adaptive management literature suggests that regulatory decision making need not be either.[156] Existing natural resource legal processes and goals simply do not reflect how natural systems are complex adaptive systems or how information is effectively obtained.[157] In the past, the conventional static model may have had substantial advantages. Such a clear bright-line mandate for resource conservation could serve to counteract political opposition from focused economic interests during implementation.[158] Furthermore, the costs of relying on a historical baseline are likely to be more modest, as there is less need for expensive post-decision monitoring of ambient effects or the adjustment of decisions to account for changed conditions.[159] Though decisions in conventional natural resources management undoubtedly were subject to uncertainty and involved assessments of dynamic ecological conditions, such uncertainty and ecological change was relatively bounded. Accordingly, though

153. *See id.*

154. *See, e.g.*, Camacho, *supra* note 24, at 29, 38; Camacho, *supra* note 28, at 327–29. Another constraint on agencies is that many natural resources laws assign agencies the duty to observe and manage ecological systems based on a human time scale that is very compressed. *See* Camacho, *supra* note 85, at 233. This myopia is reinforced by a representative democratic system that relies on two-, four-, or six-year election cycles, focusing attention on short-term baselines and overlooking longer-term shifts.

155. *See supra* notes 8–16 and accompanying text.

156. *See supra* notes 34–39 and accompanying text.

157. *See* Karkkainen, *supra* note 27, at 196–97 ("[W]e have constructed an architecture of laws and management systems that are poorly matched to the challenge of managing ecosystems as complex dynamic systems.").

158. *See* Camacho, *supra* note 85, at 245–46 (stating that a bright-line historical baseline has the advantage of simplicity and serving as a shield from intense political pressure); Holly Doremus, *Adapting to Climate Change Through Law that Bends Without Breaking*, 2 SAN DIEGO J. CLIMATE & ENERGY L. (forthcoming 2011) (manuscript at 9), *available at* http://ssrn.com/abstract=1628255 (stating environmental law traditionally relied on a number of uncompromising conservation precommitments that would buttress conservation goals in the face of political pressure).

159. *See* Bradley C. Karkkainen, *Toward a Smarter NEPA: Monitoring and Managing Government's Environmental Performance*, 102 COLUM. L. REV. 903, 940 (2002) ("Mandatory postdecision monitoring is not without its disadvantages, the most obvious of which is cost. Monitoring is not free.").

assessments made for initial management decisions were perhaps crude, there nonetheless were plausible reasons for treating protected lands as static in the past.

However, those reasons are significantly less persuasive as a result of global anthropogenic climate change. Climate change threatens to make static preservationism very difficult, if not impossible, to achieve.[160] As such, if the conservation objectives of natural resources law are not changed from a preservationist focus, climate change threatens to make law and conservation seem futile.[161] Perhaps more importantly, continuing to manage based solely on an initial determination grounded in limited information makes little sense, particularly in the context of natural resource adaptation in which uncertainty is considerable. Similarly, failing to monitor for changes in background conditions and take advantage of the opportunity to gain new information about the performance of adopted strategies would almost certainly prove costly and lead to ineffective management. Accordingly, as an accelerant of change and promoter of uncertainty, climate change makes the rigidity that exists in natural resources law particularly evident and unsustainable.

The substantive and procedural limitations of existing natural resources governance also depend on each other in a number of ways, and their joint incompatibility with climate change further reinforces the need for a departure from such static regulatory goals and processes. First, the static model of nature promoted by the historical preservationism goal serves to fortify natural resources law's unadaptive model of regulation. The prevailing front-end, comprehensive rationality approach embedded in natural resources regulatory decision making assumes and relies on a presumption that conditions are not likely to change significantly after the initial decision.[162] Because historical preservationism has similarly presumed that ecological conditions do not change significantly, it has served to reinforce a reliance on a front-end, static regulatory process. However, this justification for rigid regulatory decision making becomes significantly weaker once one accepts that natural systems are likely to change over time.

Second, the static understanding of nature assumed by a historical preservationist goal is also congruent with the regulatory segmentation currently prevalent in American natural resources governance.[163] Because of the inherent mutability and mobility of ecosystems and their

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160. *See supra* Part I.A.

161. *See* Craig, *supra* note 95, at 33–35.

162. *See* Karkkainen, *supra* note 27, at 200–01.

163. *See supra* notes 50–51 and accompanying text.

constituents, a historical preservation goal could only be possible if lands subject to such an objective were segmented and treated as independent from others. Regulatory segmentation by definition allows different types of lands to be segmented and thus more easily treated as distinct from or unconnected to others. In this sense, existing regulatory fragmentation is in part a symptom of historical preservation goals.

Climate change makes obvious, however, that biota will need to change or shift to accommodate climatic shifts or face extinction.[164] A fragmented system is likely to be particularly inadequate at managing the broad, landscape-scale transformations expected from climate change. For many species on reserve lands, changes in climate conditions will make existing protected ranges unsuitable as habitats, necessitating a shift in range[165] often from one jurisdiction to another (e.g., from public to private land, from state to federal land, or from federal BLM land to federal wilderness areas). In addition to both topographical and human-induced physical dispersal barriers, many such range shifts will be hindered by differences in management between jurisdictions. Regulatory conflict is also likely to occur between place-based preservationist laws (e.g., those governing national parks management)[166] and species-focused preservationist laws (e.g., endangered species laws).[167] If a member of a listed endangered species migrates into a national park outside its historical range, such movement might place preservationist national park management (perhaps even requiring removal) in conflict with such federal or state endangered species law. In addition, a member of an endangered species that attempts to migrate into areas outside its historical range might

164. *See, e.g.*, O. Hoegh-Guldberg et al., *Assisted Colonization and Rapid Climate Change*, 321 SCIENCE 345, 345 (2008) ("Rapid climatic change has already caused changes to the distributions of many plants and animals, leading to severe range contractions and the extinction of some species."); Parry et al., *supra* note 9, at 11 ("The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances . . . and other global change drivers . . . ."); Thompson Webb III, *Past Changes in Vegetation and Climate: Lessons for the Future*, *in* GLOBAL WARMING AND BIOLOGICAL DIVERSITY, *supra* note 13, at 59, 60 ("[I]t is likely many plant species will be unable to move their ranges rapidly enough to keep up with such a rapidly shifting climate . . . .").

165. *See* Parry et al., *supra* note 9, at 11 (projecting that twenty to thirty percent of species will face an "increased" risk of extinction if average global temperatures rise more than 1.5 to 2.5 degrees Celsius). A leading but often contested article in *Nature* concluded that, by 2050, up to two-thirds of species will need to migrate or be moved to new habitats to survive. *See* Chris D. Thomas et al., *Extinction Risk from Climate Change*, 427 NATURE 145, 146 (2004).

166. *See* National Park Service Organic Acts, Pub. L. No. 64-235, 39 Stat. 535 (1916) (codified as amended at 16 U.S.C. §§ 1–4 (2006)).

167. *See* Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544 (2006); ARIZ. REV. STAT. § 17-296 (LexisNexis 2010); COLO. REV. STAT. § 33-2-105.5 (2009); FLA. STAT. ANN. § 379.231 (2011); FLA. STAT. § 379.2291 (2011); NEB. REV. STAT. ANN. § 37-807 (LexisNexis 2010); NEV. REV. STAT. § 503.584(2)(a) (2010); N.C. GEN. STAT. § 113-331(2) (2009).

be considered nonnative and potentially invasive under federal or state invasive species laws.

As a result of climate change, then, regulatory segmentation in natural resources law is likely to lead to increased conflict between inconsistent management objectives. At a minimum, such goals will have to be reconciled, and management coordinated, to limit unintended detrimental effects of management of each area on the others. Yet, the acceptance that biota may need to adapt to climatic changes by shifting their range to other landscapes necessitates a departure not only from a purely segmented focus, but also from historical preservationism. If natural resources management continues to require the maintenance of historical conditions as regulatory fragmentation combines with other environmental and human-induced stressors to hinder species migrations, managers will have to accept that ecological systems will continue to decline in ecological diversity and function.[168]

Third, like its historical preservationist counterpart, the human-nature dualism embedded in wilderness preservation has also influenced and contributed to regulatory segmentation by facilitating and promoting the severance of human-shaped landscapes from "natural" landscapes. In this sense, segmentation is needed to achieve not only the bifurcation between native and nonnative, but also the human and nature dualism. To accommodate the goal of keeping humans out of pristine areas, natural resources law created areas where human activities and nonnative species are acceptable and prevalent, and others where they are to be prevented, minimized, or their effects mitigated. This dichotomy places human-dominated landscapes such as agricultural, suburban, and urban lands on one side, and reserve lands subject to a wilderness mandate on the other.[169] Because this division focuses on the extent of human influence, it is perhaps unsurprising that in man-made and other human-dominated environments, the law allows extensive human interference to deal with and manage change without controversy. Adaptations to prepare for or reduce the effects of climate change that involve changes in urban infrastructure or crop selection are accepted, while active management such as assisted migration[170] is much more contentious for "natural," less disturbed landscapes.

168. *See* Camacho, *supra* note 85, at 247.

169. Of course, human influence pervades even reserved lands, so a range of human uses exist on reserved public lands as well. As a result, currently there is more of a continuum of public lands, which range from the more disturbed (such as BLM grazing or mining lands) to less manipulated areas (such as federal wilderness).

170. *See* Camacho, *supra* note 85, at 211–13.

In enabling this severance, the human-nature dualism facilitated problems in natural resources management. In particular, the bifurcation advanced by a human-nature dualism makes it easier to disregard or forget that human-dominated landscapes and less disturbed lands massively influence each other. Segmentation of lands might have helped much of the public see a division between human activities on the one hand and their effects on natural systems on the other.[171] Aldo Leopold argued that such segmentation essentially allowed reserved lands to serve as an excuse for failing to rectify or improve the management of human-dominated landscapes.[172] More importantly, even if natural resource managers acknowledge that natural and human systems are inextricably connected, regulatory segmentation makes it considerably more difficult to address. Though there are many factors exogenous to land reserves that affect them, the segmentation model fostered by dualism raises significant barriers for natural resource managers to address these effects.

Finally, the lack of procedural flexibility and the substantive emphasis on preservationism in natural resources law both function to devolve significant control of decision making to natural resource managers. First, by not imposing requirements and providing incentives to natural resource managers to monitor, revisit, and adjust decisions publicly, existing natural resources law makes it difficult for such agencies to be reviewed and evaluated by legislatures, other administrative bodies, or members of the

171. *Cf.* Cronon, *supra* note 106, at 484–85 ("[T]o the extent that we live in an urban-industrial civilization but at the same time pretend to ourselves that our *real* home is in the wilderness, to just that extent we give ourselves permission to evade responsibility for the lives we actually lead. We inhabit civilization while holding some part of ourselves—what we imagine to be the most precious part—aloof from its entanglements. We work our nine-to-five jobs in its institutions, we eat its food, we drive its cars (not least to reach the wilderness), we benefit from the intricate and all too invisible networks with which it shelters us, all the while pretending that these things are not an essential part of who we are. By imagining that our true home is in the wilderness, we forgive ourselves the homes we actually inhabit."); Ramachandra Guha, *Radical American Environmentalism and Wilderness Preservation: A Third World Critique*, *in* THE GREAT NEW WILDERNESS DEBATE, *supra* note 104, at 231, 239 ("[In the United States] the enjoyment of nature is an integral part of the consumer society. The private automobile (and the life style it has spawned) is in many respects the ultimate ecological villain, and an untouched wilderness the prototype of ecological harmony; yet, for most Americans it is perfectly consistent to drive a thousand miles to spend a holiday in a national park.").

172. *See* Aldo Leopold, *Land-Use and Democracy*, AUDUBON, Sept.–Oct. 1942, at 259, *reprinted in* THE RIVER OF THE MOTHER OF GOD AND OTHER ESSAYS BY ALDO LEOPOLD 295, 299 (Susan L. Flader & J. Baird Callicot eds., 1991) ("It seems to me that sanctuaries are akin to monasticism in the dark ages. The world was so wicked it was better to have islands of decency than none at all. . . . Once established, these islands became an alibi for lack of private reform. People said: 'We pay the bills for all this virtue. Let goodness stay where it belongs, and not pester practical folks who have to run the world.' . . . The more monasteries or sanctuaries, the grimmer the incongruity between inside and outside.").

general public.[173] Not requiring agencies to learn also makes such public decisionmakers less accountable to the public.[174]

In addition, because a historical preservationist model fundamentally relies on a scientific evaluation of current or past conditions for the normative determination of what future conditions should be, it treats natural resources management as a scientific, expert-driven analysis. A natural resources management goal tethered to a historical baseline treats what currently exists (or historically existed) as what *should* exist in the future. In this sense, historical preservationism converts ecology into a normative science.[175] As a result, a historical preservation management goal makes the scientific determination of existing or past conditions the primary management question. It thus serves to treat natural resources management as the primary province of ecologists and resource managers. Together with the diminished accountability that arises from the prevailing weakness of public monitoring and adaptive management, preservationism has enabled natural resources management to rely heavily on an ostensibly expert-driven model of administrative regulation. As detailed below, this focus on expertise to determine management goals will undoubtedly need to be reformulated for natural resources law to effectively work to help ecological systems and natural resources law itself adapt to the rapid and accelerating effects of a changing climate.

IV. MAKING NATURAL RESOURCES LAW MORE ADAPTABLE

Because the substantive and procedural shortcomings of natural resources law detailed above have been mutually reinforcing, the alterations necessary to make natural resources management more effective are likely to be linked as well. Natural resources law must be modified to

173. *See* Biber, *supra* note 25, at 45–47 (describing how monitoring data can provide courts with an independent empirical basis for closer review of agency decisions).

174. *See* Camacho, *supra* note 28, at 343–44 ("[S]ubjecting program implementation to ongoing, open monitoring and evaluation . . . serves to curb opportunities for bias. . . . By providing an open framework for evaluating a regulatory program, adaptive regulation can enlist the public and Congress to help the regulatory process evolve."); Michael C. Dorf & Charles F. Sabel, *A Constitution of Democratic Experimentalism*, 98 COLUM. L. REV. 267, 288, 321 (1998) (asserting that public participation in regulator performance evaluation can increase the accountability of regulatory institutions); Jody Freeman, *The Private Role in Public Governance*, 75 N.Y.U. L. REV. 543, 549, 638, 663–66 (2000) (arguing that including private actors in the regulatory process can foster accountability).

175. *Cf.* Mark Sagoff, *Native to a Place, or What's Wrong with Exotic Species?*, *in* VALUES AT SEA: ETHICS FOR THE MARINE ENVIRONMENT 93, 106 (Dorinda G. Dallmeyer ed., 2003) ("No one can say scientifically that it is better to stand by the native oyster than to introduce the alien competitor. . . . Biological and ecological science . . . describes what may happen if nonnative [species] are allowed to prosper in the bay. These sciences may predict but cannot evaluate the consequences. Ecology should not attempt to become a normative science.").

be better adapted to a dynamic world. Both the means and the ends of natural resources management must be changed to better prepare for the effects of climate change.

As I have argued elsewhere,[176] natural resources law needs to move more toward a model of active management that is not primarily motivated by a fidelity to past conditions. Rather than leaving nature alone, or putting things the way they were, natural resources laws must be refocused toward promoting desirable future ecological conditions in light of climatic changes. Managers and regulators must be charged with protecting and promoting the fitness and resilience of valuable ecosystem processes, instead of focusing on particular preexisting species or collections of species. Management goals must be oriented toward facilitating the development of new valuable biotic interactions rather than hindering them based on devotion to the past. This reorientation would often seek to promote existing ecological constituents by using past conditions as a guide. However, its primary focus would not be to revert to historic conditions but rather to ensure that the ecosystem is healthy under future conditions. Where such ecological fitness cannot be achieved through merely passive management, more active approaches should be considered.

A rejection of the treatment of humans and nature as separate and distinct does not lead to an unconditional acceptance of the permissibility of active management of all resource areas. To be sure, there may be many significant precautionary reasons for not actively managing reserve areas. Perhaps the most important reason for not managing reserve areas actively is the substantial uncertainty that exists regarding the efficacy and unintended effects of human interventions.[177] There are many examples of human interventions that have had significant adverse and inadvertent effects on ecological systems,[178] and these examples and the increased uncertainty that accompanies climate change counsel strongly against the wholesale reliance on active management of ecosystems. Natural resources management certainly must account for the risks and limited knowledge regarding potential adaptation strategies in trying to minimize negative and maximize desirable future change.

However, the advent of climate change also makes clear that choosing to not employ strategies that promote ecological health on the basis that

176. *See* Camacho, *supra* note 85, at 243–53.

177. *See id.* at 185–86.

178. *See, e.g.*, *id.* (describing several species introductions that became invasive, such as certain oyster species and kudzu in the United States and rabbits and cane toads in Australia); Anthony Ricciardi & Daniel Simberloff, *Assisted Colonization Is Not a Viable Conservation Strategy*, 24 TRENDS ECOLOGY & EVOLUTION 248, 249–50 (2009) (arguing that species translocation may have a severe impact on food webs and other ecosystem attributes).

doing so will interfere with natural wild areas will increasingly have significant irreparable ecological costs that must be considered. In all likelihood, there will be many instances in which passive management strategies will be preferable because of uncertainties regarding the effects of more active human intervention. Yet as a result of climate change, there increasingly will be circumstances in which active management may be warranted to prevent or minimize substantial losses in ecological health. Of course, a paradigm shift toward conserving ecological function raises many difficult questions that remain largely unexplored in natural resources law. Perhaps the most important of these is that though climate change reveals that a fidelity to stasis is increasingly untenable, an alternative, future-focused baseline is still difficult to define.[179] Such a focus opens up the natural resources management process to the substantially more complex inquiry into the relative value of the various natural resources under consideration for protection or use. Even if one limits the management objective solely to maximizing ecosystem function or health and overlooks other aesthetic, recreational, economic, and historic considerations, an analysis of ecological value remains open to a variety of interpretations. Ecological considerations may be directed toward promoting biodiversity,[180] though there remains a host of different ways to define and/or measure biodiversity;[181] toward maximizing ecosystem productivity,[182] however defined; or even some combination thereof. In

179. *See* Camacho, *supra* note 85, at 245.

180. *See, e.g.*, J.B. Ruhl, *Working Both (Positivist) Ends Toward a New (Pragmatist) Middle in Environmental Law*, 68 GEO. WASH. L. REV. 522, 542 (2000) (reviewing DANIEL A. FARBER, ECO-PRAGMATISM: MAKING SENSIBLE ENVIRONMENTAL DECISIONS IN AN UNCERTAIN WORLD (1999)) ("Scientific research suggests that the concept of biological diversity, or biodiversity, is the key metric of ecosystem health.").

181. For a discussion of various measures of biodiversity, see Andy Purvis & Andy Hector, *Getting the Measure of Biodiversity*, 405 NATURE 212, 212–18 (2000); *see also* ANNE E. MAGURRAN, MEASURING BIOLOGICAL DIVERSITY 9 (2004) (providing an overview of the primary procedure through which diversity is measured, including modeling, statistics, and estimation techniques); Brian H. Walker, *Biodiversity and Ecological Redundancy*, 6 CONSERVATION BIOLOGY 18, 19 (1992) ("Decline in biodiversity includes all those changes that have to do with reducing or simplifying biological heterogeneity, from individuals to regions. Included are such phenomena as phenotypic plasticity; genetic variability within a population (allowing for a wide range of genotypic responses to environmental conditions); ecotypic variation (genetic variability between populations within a species); species richness (the number of species in a community); species (alpha) diversity (involving both the number of species and the relative numbers of individuals per species); functional diversity (the relative abundances of functionally different kinds of organisms); gradient (beta) diversity, which extends to diversity resulting from speciation of ecological equivalents (gamma or delta diversity); community diversity (the number, sizes, and spatial distribution of communities, sometimes referred to as patchiness); and even the diversity of the scales of patchiness (landscape diversity).").

182. *See, e.g.*, Alyson C. Flournoy et al., *Harnessing the Power of Information to Protect Our Public Natural Resource Legacy*, 86 TEX. L. REV. 1575, 1594 (2008).

short, there is no universal agreement regarding what ecosystem health means.

To be sure, just as different public lands in the United States are subject to a diversity of management goals,[183] some reserve lands could be managed to prioritize the promotion of biodiversity while others could emphasize ecosystem productivity. More broadly, different lands could focus on promoting other social values such as recreational, aesthetic, historic, scientific, or economic uses. Indeed, some reserves could rely on more active management of ecological areas while others continue to concentrate on more passive management. This less intrusive approach might be particularly useful in circumstances in which the ecological area will be fairly ecologically stable with climate change, is poorly understood, and is ecologically sensitive. In such circumstances—indeed perhaps in many circumstances—it might make more sense to leave ecological systems alone. Resource managers and legislators need to weigh the possibility, however, that ignoring or barring management of an ecological community might lead to substantial costs in ecological diversity and/or productivity.

Just as the goal of promoting future ecological value remains embryonic, there is also not a developed approach for identifying the appropriate ecological units resource managers should focus on in management, prioritization, or making tradeoffs between competing resource uses or services[184] or what role the distributive effects of such tradeoffs should serve in natural resources management. A key underlying challenge of relying on a goal that seeks to promote desired future conditions is that doing so makes natural resources management more vulnerable to the political pressures often wielded against natural resource conservation.[185] In addition, a focus on valuing ecosystem services and ecological health is a more complicated message for coordinating and mobilizing conservation groups and other diffuse stakeholders than the crude simplicity of preservationist and dualist goals. As such, concurrent with removing the strict preservationist baseline, natural resources law

183. *Compare* 16 U.S.C. § 1 (2006) (establishing the National Park Service's core preservation mandate of conserving "the scenery and the natural and historic objects and the wild life therein . . . as will leave them unimpaired"), *and* 16 U.S.C. §§ 1131–1136 (2006) (providing the Wilderness Act's central goal of preserving wilderness areas of "undeveloped Federal land retaining its primeval character and influence"), *with* 16 U.S.C. § 1604(g)(3) (2006) (providing the National Forest Management Act's mandate that national forests must be managed for multiple uses, including resource extraction and timber harvest).

184. *See* Camacho, *supra* note 85, at 248–53.

185. *See* David A. Dana, *Existence Value and Federal Preservation Regulation*, 28 HARV. ENVTL. L. REV. 343, 373 (2004).

must incorporate other procedural mechanisms that protect conservation uses over more tangible and easily priced consumptive uses.[186]

Undoubtedly, scientific data can and must facilitate the resolution of these and other complicated questions. Managers would need to engage in at least three enterprises: (1) identifying and reducing uncertainty about projected shifts in climatic and ecological conditions, (2) identifying and reducing uncertainty about the past performance and likely effectiveness of possible management strategies, and (3) assessing the ecological and social value of and synergy between possible ecological constituents. This substantive vision of natural resources management would thus still rely on substantial manager expertise in determining ecological value, but it would place considerably greater information gathering pressure on already isolated and information-deprived natural resource managers.

More fundamentally, climate change makes clear that natural resources management should not be the sole province of ecologists or other scientific experts. As natural resources law necessarily becomes untethered to a historical baseline, the key questions raised regarding the appropriate goals and priorities for managing natural resources are not answerable exclusively through a scientific, objective analysis. These value and tradeoff judgments are public policy decisions and should be resolved though the democratic process of decision making.[187] Though science will be integral to developing approaches to both understanding ecological systems and measuring the value of particular components, such tradeoff decisions are ultimately normative.[188]

Because this vision of natural resources management is even less scientific, it emphasizes that natural resources law's core function should be improving the process of natural resource decision making. Natural resources law under climate change has the potential to be a great fit for overlapping, decentralized governance. Because of the massive uncertainty regarding the nature and scope of local effects of climate change,[189] it is hard to identify a single appropriate regulatory scale. Such characteristics fit well with a decision-making model that relies on multiple overlapping authorities. Overlapping jurisdiction can provide regulatory redundancy to

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186. *See, e.g.*, Doremus, *supra* note 158 (manuscript at 25–37) (identifying a number of substantive and procedural mechanisms to buttress long-term conservation goals in the face of short-term economic interests).

187. *Cf.* Donald Waller, *Getting Back to the Right Nature: A Reply to Cronon's "The Trouble with Wilderness," in* THE GREAT NEW WILDERNESS DEBATE, *supra* note 104, at 540, 563 ("Our science will also allow us to critically evaluate what will, and what will not, suffice to stem the hemorrhage of biodiversity. Science, however, is only a tool whose success in these efforts will depend utterly on our values.").

188. *Id.*

189. *See supra* notes 17–24 and accompanying text.

fill in regulatory gaps and thus provide resiliency.[190] In addition, the existence of many different regulatory authorities provides considerable opportunities for experimentation and interagency learning.[191] However, as detailed earlier, existing natural resources governance is poorly designed to promote these potential benefits.[192] Natural resources law currently leaves resource managers isolated in addressing uncertain regulatory problems and fails to pressure regulators to learn.

To address the limitations of existing natural resources governance, I have previously advocated for the adoption of a cross-jurisdictional infrastructure to promote agency learning and accountability.[193] One component of this infrastructure is an adaptive governance framework that builds on adaptive management theory, including required monitoring, assessment, and adjustment of all agency strategies and processes regarding their progress toward identified regulatory goals.[194] Though this framework builds on adaptive management, it seeks to rely on the integration of monitoring, assessment, and evaluation throughout the regulatory process and not only through the use of formal adaptive management. The express use of adaptive management may be valuable and/or necessary in some circumstances, but a range of less rigid, rigorous, and expensive forms of adaptive regulation that mandate and incentivize agency and stakeholder monitoring, contingency planning, and periodic adjustment of regulatory decisions could and should be relied on as well.[195] A systematic process of sustained information collection and periodic alteration of regulatory strategies should apply throughout the regulatory process, including not only the assessment of individual resource decisions and management plans, but also the evaluation of adopted decision processes and agencies against programmatic goals.[196]

In addition, this learning infrastructure would include a shared and public information network that collects and disseminates information

190. *See* Engel, *supra* note 80, at 178; Schapiro, *supra* note 79, at 290; Biber, *supra* note 25, at 71. *But see* O'Connell, *supra* note 67, at 1679–80 (noting that redundancy raises a risk of agency freeriding and under-regulation).

191. *See* Adler, *supra* note 75, at 137 ("[D]ecentralization, and the resulting policy experimentation and interjurisdictional competition, can encourage policy innovation as policymakers seek to meet the economic, environmental, and other demands of their constituents. As a result of such competition, states are able to learn from each others' successes and failures. This competition allows states to act as environmental 'laboratories' developing new and improved ways of addressing environmental concerns.") (citations omitted).

192. *See supra* Part I.B.

193. *See* Camacho, *supra* note 24, at 64–76.

194. *Id.* at 72–73.

195. *Id.*

196. *Id.*

between jurisdictions.[197] The information network should include sustained collection and generation of ambient monitoring data, particularly on climate change effects, the development of localized models for projecting future effects, and information on potential adaptation strategies.[198] More importantly, it should also compile data on the past and continued performance of adopted management strategies in every jurisdiction.

Encouragingly, the White House Interagency Climate Change Adaptation Task Force has recommended the development of a federal information clearinghouse and other measures consistent with developing the information generation and dissemination capacity of regulators.[199] The task force also suggested encouraging ongoing federal agency prioritization, monitoring, evaluation, and learning to promote better adaptation planning.[200] Congruent with these goals, the task force recommended the establishment of performance metrics for evaluating federal adaptation efforts, as well as the development of partnerships and regional consortia to formulate adaptation strategies.[201] In March 2011, relying on this report, the White House Council on Environmental Quality ("CEQ") issued instructions to all federal agencies to (1) develop a climate change adaptation policy statement by June 2011 that adopts "the Interagency Climate Change Adaptation Task Force's guiding principles and framework for adaptation planning," (2) submit to CEQ an agency climate adaptation plan by June 2012, and (3) "pursue opportunities for sharing and coordination across the Federal community."[202] Though these activities primarily focus on federal-level adaptation,[203] they nonetheless indicate that the current administration is at least considering, if not moving toward, the development of an information infrastructure for managing uncertainty in climate change adaptation planning and management.

To this end, recently, at least some federal agencies are working to increase their capacity to collect climate data and create clearinghouses to distribute scientific information to their regional offices, state agencies, and the public related to climate change adaptation planning.[204] The Department

197. *Id.* at 65–66.

198. *Id.* at 66.

199. *See* INTERAGENCY TASK FORCE REPORT, *supra* note 60, at 33–34.

200. *See id.* at 27–29.

201. *See id.* at 49–51.

202. COUNCIL ON ENVTL. QUALITY, INSTRUCTIONS FOR IMPLEMENTING CLIMATE CHANGE ADAPTATION PLANNING IN ACCORDANCE WITH EXECUTIVE ORDER 13514, at 3–5 (2011), *available at* http://www.whitehouse.gov/sites/default/files/microsites/ceq/ADAPTATION%20FINAL%20IMPLEMENTING%20INSTRUCTIONS%203_3.pdf.

203. *See id.* at 9.

204. *See generally* PEW CTR. ON GLOBAL CLIMATE CHANGE, CLIMATE CHANGE ADAPTATION: WHAT FEDERAL AGENCIES ARE DOING (2010), *available at*

of the Interior, for example, is in the early stages of identifying and eventually opening eight regional Climate Science Centers ("CSCs") and partnering with other federal agencies, state entities, and interested nongovernment stakeholders to create Landscape Conservation Cooperatives ("LCCs").[205] LCC staff will "assist partners in integrating status and trends data with effectiveness monitoring and applying science-based monitoring programs to determine if resource goals are being met, evaluate and adapt management goals and strategies, and work with CSC staff to reduce key uncertainties and improve the next round of forecasts."[206] This initiative is still in a very early stage,[207] and, like many other preceding regulatory initiatives, may simply call for the use of adaptive regulatory approaches and inter-jurisdictional information sharing without providing clear requirements, sufficient resources, or any other incentives for continued and sustained monitoring, adaptive management, and agency learning.[208] Nonetheless, it is encouraging to see that the planning stages call for extensive information gathering, partnerships

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http://www.pewclimate.org/docUploads/FederalGovernmentLeadershiponAdaptation_Nov2010.pdf (describing briefly the many actions federal agencies are taking regarding climate adaptation).

Similarly, the Obama administration continues the recent trend of integrating adaptive management in its most recent resource management initiatives. For example, in July 2010 President Obama signed an executive order adopting the final recommendations of the Interagency Ocean Policy Task Force in their entirety. Council on Envtl. Quality, *The International Ocean Policy Task Force*, THE WHITE HOUSE, http://www.whitehouse.gov/administration/eop/ceq/initiatives/oceans (last visited Apr. 28, 2011). They include both adaptive management and monitoring provisions, stating that "[h]uman activities that may affect ocean, coastal, and Great Lakes ecosystems should be managed using ecosystem-based management and adaptive management, through an integrated framework that accounts for the interdependence of the land, air, water, ice, and the interconnectedness between human populations and these environments," and that "[m]anagement should include monitoring and have the flexibility to adapt to evolving knowledge and understanding, changes in the global environment, and emerging uses." THE WHITE HOUSE COUNCIL ON ENVTL. QUALITY, FINAL RECOMMENDATIONS OF THE INTERAGENCY OCEAN POLICY TASK FORCE 16 (2010), *available at* http://www.whitehouse.gov/files/documents/OPTF_FinalRecs.pdf.

205. *Interior's Plan for a Coordinated, Science-Based Response to Climate Change Impacts on our Land, Water, and Wildlife Resources*, U.S. DEP'T OF THE INTERIOR, 1, http://www.doi.gov/whatwedo/climate/strategy/loader.cfm?csModule=security/getfile&PageID=23288 (last visited Apr. 28, 2011) [hereinafter *Interior's Plan*]. For an example of such an LCC, see generally *California Landscape Conservation Cooperative*, U.S. FISH & WILDLIFE SERV. (Dec. 2009), http://library.fws.gov/LCC/california.pdf.

206. *Interior's Plan*, *supra* note 205, at 5.

207. *Climate Science Centers*, U.S. DEP'T OF THE INTERIOR, http://www.doi.gov/whatwedo/climate/strategy/CSC-Map.cfm (last visited Apr. 28, 2011) (indicating that many of the Climate Science Center sites have not been determined yet and that this process will continue into the future).

208. *See* Camacho, *supra* note 24, at 47–48 (suggesting a range of tools for promoting agency and stakeholder learning, including integration in manager performance evaluation and compensation, financial or other regulatory inducements for regulated entities, and enlisting stakeholders and outside agencies to buttress monitoring or evaluation).

between government and nongovernment actors, and the distribution of data that will enable stakeholders to adapt their natural resources management decisions based on frequently updated information.

CONCLUSION

The existing governance system for managing natural resources in the United States has only a limited capacity to cope with the effects of climate change because of its reliance on static models of nature and decision making. Existing natural resources management institutions are not well suited to foster effective adaptation because they are unadaptive and fragmented, and thus poorly designed to cultivate systematic learning and manage uncertainty. This limitation is related to and exacerbated by a heavy focus in many natural resources laws on managing resources toward preserving historical conditions and minimizing human interaction with ecological systems. The emphases on minimal management and historical preservation will be increasingly misplaced, and in fact these two goals will be more and more in direct tension with each other in light of modern climate changes. Though these weaknesses of natural resources law existed prior to the development of global anthropogenic climate change, its onset makes these limitations particularly evident and the achievement of conventional management goals increasingly untenable.

The historical preservationist and passive ends of natural resources law, and the static means through which they are expected to be achieved, all arise from the legal system's discomfort with integrating and managing uncertainty and change. They also depend on and reinforce each other. Historical preservation's static model of nature and the human-nature dualism embedded in wilderness preservation help reinforce existing regulatory fragmentation and natural resources law's unadaptive model of regulation. Reciprocally, historical preservation would not be possible without wholesale landscape segmentation. Moreover, a reliance on a historical ecological baseline, an emphasis on partitioning humans from natural systems, and a lack of procedural flexibility in natural resources law all encourage entrusting natural resource decision making to presumed expert resource managers. This serves to limit public understanding of and involvement in resource management decisions.

The solutions to the shortcomings of these two static visions are thus linked. First, natural resources management must shift its ends toward promoting an increased emphasis on limiting ecological shifts or interactions that are likely to be detrimental to the ecological function and biodiversity of ecological reserves given projected shifts in climatic conditions, as well as seeking to foster those shifts likely to be beneficial. Such a change would undoubtedly be fundamental, away from a simplistic static analysis of whether an ecological constituent preexisted European settlement as the determining factor toward an evaluation of the ecological and social significance of that constituent. This substantive vision of natural resources management would still rely on substantial manager expertise in determining ecological value, but places considerably greater information-gathering pressure on already-isolated and information-deprived natural resource managers.

As a result, fostering an effective shift in natural resource goals that accommodates the transformative effects of climate change necessitates a concomitant structural transformation in the natural resource decision-making process. The means of natural resources law must be fundamentally altered to better manage uncertainty and change, to inform and learn from the public about the value of ecological resources, and to galvanize public deliberation on natural resource decisions. This includes a regulatory process premised on promoting stakeholder involvement, cultivating agency and stakeholder learning, and reducing uncertainty over time. Because the core normative analysis would necessarily be less expert-driven, it would shift natural resource managers toward a more mediative role.[209]

Such a learning infrastructure would not only serve to cultivate agency accountability and learning. It would also help increase information to, and facilitate transparent debate and deliberation among, stakeholders, legislatures, and the public about the considerable value of ecological systems, processes, and particular ecosystem constituents, as well as the tradeoffs of different management strategies. Moreover, it would promote opportunities for interjurisdictional information sharing while accommodating the various diversity benefits of overlapping jurisdiction. Finally, this infrastructure would help provide the framework for establishing measurable goals and priorities for the active forward-looking management of natural resources in a changing world. By transforming a decidedly static governance system to be more dynamic and adaptive—both in its goals and in how such goals are advanced—natural resources law can make ecological systems more resilient and provide some hope that these ecological communities on which humans are so dependent may be able to sustain the effects of a rapidly changing climate.

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209. *See* Camacho, *supra* note 28, at 352.