COLLABORATIVE AND ADAPTIVE WILDLIFE MANAGEMENT IN A CHANGING CLIMATE

by

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ABSTRACT

Wildlife, one of the United States' most treasured natural resources, faces a dire future. Changing climate conditions will upend the natural world wild creatures inhabit. Dramatic shifts in precipitation, spreading disease, cascading ecological events, and catastrophic events such as wildfires and floods will present wildlife with challenges of a degree and frequency not seen in U.S. history. These shifts in climate will in turn bring to bear great pressure on the heralded U.S. approach to wildlife management.

Ill equipped to respond to the jurisdictional fragmentation and scientific uncertainty that will predominate wildlife management in a changing climate, U.S. wildlife managers must seek out new tools to cope with the difficulties that lie ahead. Collaborative governance and adaptive management—management techniques designed to cope with fragmentation and uncertainty—have obvious appeal. While both have failed to date to deliver their theoretical appeal in practice, these failures can be readily attributed to inadequate implementation efforts. Remedying those deficiencies can greatly increase the likelihood of successful implementation.

The federal land management agencies, which oversee the vast majority of wildlife habitat in the United States, are well suited to advance

collaborative and adaptive experiments in wildlife habitat management. Acting as hubs to deploy collaboration and adaptation more broadly in the context of wildlife management, the Forest Service, Bureau of Land Management, Fish and Wildlife Service, and National Park Service should incorporate implementation baselines to ensure the appropriate and sufficient deployment of collaborative and adaptive processes. Such efforts will not eliminate the grave risks wild animals face, but will help wildlife managers to have at least a chance of ushering the United States' other inhabitants through the storm.

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I. INTRODUCTION

We stand guard over works of art, but species representing the work of eons are stolen from under our noses.

–Aldo Leopold.[1]

Five times over the last half billion years, Earth has lost profound quantities of its living species.[2] The most recent mass extinction occurred roughly 65 million years ago, when the dinosaurs disappeared.[3] As a result of human influences, including changing climate, invasive species, and habitat destruction,[4] we might now be experiencing the sixth great loss of life from the planet.[5] Current rates of extinction are debated, in part because too little is known about many species,[6] but the evidence demonstrates increasing rates of species disappearing as a result of human causes.[7]

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[1] GAME MANAGEMENT, at xxxi (1986 ed.).

[2] *See, e.g.*, EDWARD O. WILSON, THE DIVERSITY OF LIFE 31 (1999 ed.); RICHARD E. LEAKEY & ROGER LEWIN, THE SIXTH EXTINCTION (1996); *see also* David B. Wake & Vance T. Vredenburg, *Are We in the Midst of the Sixth Mass Extinction: A View from the World of Amphibians*, *in* IN THE LIGHT OF EVOLUTION: BIODIVERSITY AND EXTINCTION 27 (John C. Avise et al. eds. 2008) (summarizing five prior mass extinctions).

[3] LEAKEY & LEWIN, *supra* note 2.

[4] George W. Gilchrist & Donna G. Folk, *Introduction: Evolutionary Responses to Environmental Change*, *in* CONSERVATION BIOLOGY: EVOLUTION IN ACTION 141, 141-43 (Scott P. Carrol & Charles W. Fox eds. 2008).

[5] Anthony D. Barnosky et al., *Has the Earth's Sixth Mass Extinction Already Arrived?*, 471 NATURE 51 (2011); LEAKEY & LEWIN, *supra* note 2.

[6] W. Wayt Gibbs, *On the Termination of Species*, *in* ENDANGERED EARTH 5, 5-15 (2008).

[7] *See, e.g.*, Barnosky et al., *supra* note 5; Wake & Vredenburg, *supra* note 2.

The relationship between people and their natural surroundings has been a central component of culture since the dawn of time.[8] Aristotle, for example, believed that all things in nature were made "specifically for the sake of man."[9] The Book of Genesis sets forth a similarly human-centric view, commanding that humans "fill the earth and master it."[10] Yet the same text repeatedly asserts that the natural world is good in itself.[11] This tension in the ways that people see nature—for its usefulness and for its intrinsic value—has framed the human understanding of the natural world for centuries. The revered American environmental forefathers John Muir and Gifford Pinchot divided on precisely this issue.[12]

In the United States today, the human relationship with nature remains predominantly a matter of preservation versus use. Lands set aside as national parks, monuments, and wilderness areas preserve the intrinsic value of the natural world mostly undisturbed by human influence. The remainder of the natural world—including national forests, unreserved federal lands, waterways, and most wildlife—is managed primarily for its usefulness to society. The institutions that manage the natural world in

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[8] *See generally* GILBERT F. LAFRENIERE, THE DECLINE OF NATURE: ENVIRONMENTAL HISTORY AND THE WESTERN WORLDVIEW (2008) (describing historical perspectives on human relations with the natural world).

[9] POLITICS, Bk. I, ch. 8.

[10] *Genesis* 1:28.

[11] *See, e.g.*, *Genesis* 1:31 ("And God saw all that he had made, and it was very good."); *see also* FRED VAN DYKE, BETWEEN HEAVEN AND EARTH: CHRISTIAN PERSPECTIVES ON ENVIRONMENTAL PROTECTION 51 (2010).

[12] *See, e.g.*, ROBERT W. RIGHTER, THE BATTLE OVER HETCH HETCHY 66-95 (2005). Muir saw the natural world as having an independent right to existence, whereas Pinchot saw nature only for its usefulness. *Id.* at 68.

pursuit of these ends—use and preservation—are therefore built principally on this ages old tension in how people relate to nature.

A changing climate will call into question how we understand our relationships with the natural realm, and therefore the institutions through which we attempt to manage those relationships. Climate change will likely continue to drive the wave of extinction,[13] and in the process rearrange the ecological relationships that define the natural world we have come to know. In the face of certain change in natural systems, preserving the status quo of "nature" becomes increasingly challenging.[14]

At the same time, climate-driven changes will raise serious doubts about the utilitarian conception of human relations with the natural world. Utilization of resources in nature has long been predicated on maintaining sustained resource yields.[15] In this way, the utilitarian approach to nature takes a long view, much like preservation. However, such future projections cannot reasonably be made in a world dominated by change and uncertainty. Climate driven scientific uncertainty will undermine attempts to maintain sustained yields, and unforeseen circumstances will bear the potential for unexpected harm, including resource depletion.

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[13] *See* Chris D. Thomas et al., *Extinction Risk from Climate Change*, 427 NATURE 145 (2004) (predicting that "mid-range" climate change scenarios will commit 15-37% of species to extinction).

[14] Alejandro E. Camacho, *Transforming the Means and Ends of Natural Resources Management*, 89 N.C. L. REV. 1405, 1429-31 (2011).

[15] *See, e.g.*, K Freerk Wiersum, *200 Years of Sustainability in Forestry: Lessons from History*, 19 ENVTL. MGMT. 321, 322 (1995) (noting sustained yield concepts in 19th-century German forestry); James D. Nations & Ronald B. Nigh, *The Evolutionary Potential of Lacandon Maya Sustained-Yield Tropical Forest Agriculture*, 36 J. ANTHRO. RES. 1 (1980) (noting indigenous sustained-yield management of natural resources).

The impacts of a changing climate will be particularly acute for wildlife. Changes in temperature and precipitation, as well as increases in the frequency of extreme weather events, will reshape the landscapes wild creatures inhabit. While many wildlife responses to changing climate have been observed, very little is known about how or when wildlife habitat will continue to change, let alone how inhabitants will respond. The managers tasked with responding to these shifts are particularly ill-equipped to deal with the scientific uncertainty. They operate within a patchwork of political jurisdictions and legal mandates, often in isolation, though the wildlife resources they manage present common problems and will increasingly do so in the future. Such fragmentation makes it unlikely that wildlife managers will be able to respond to the challenges climate change will bring to bear on wild creatures already experiencing considerable stress from human influence.

Wildlife managers are therefore in need of new tools to cope with climate change and mitigate the losses of the forecasted sixth great extinction. Two such implements—alternative methods for managing human relations with the natural world—have shown promise. Adaptive management, the common sense idea of learning by doing, focuses on resolving uncertainty through an iterative learning process and improving the effectiveness of management actions through increased understanding of natural and human systems.[16] Collaborative governance, a management technique that is compatible with and often complimentary to adaptive management, embraces collective problem solving to bring together fragmented decision-making structures to address problems that cross jurisdictional, political, and ecological divides.[17]

Although appealing in theory, both approaches have mostly failed in practice to deliver on their theoretical promises. Resource managers implementing adaptive management have passed over the details of the iterative process, watering down adaptive management to the point that it encompasses neither learning nor doing.[18] Collaborative efforts have similarly underperformed, where they have even gotten off the ground, due to the lack of both guidance and incentives for cooperation.[19]

These implementation failures introduce increased uncertainty into the management process. Unlike traditional wildlife management, which provides resource users with the certainty of a front-end decision based on assumptions about future conditions, adaptive and collaborative management leaves open the possibility of change until uncertainty is resolved. For resource uses that require capital investments—such as mining or renewable energy generation—the uncertainty of collaboration and adaptation could

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[16] *See generally* ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (C.S. Holling ed. (1978); *see also* discussion *infra* at 80-86 and accompanying footnotes.

[17] *See* discussion *infra* at 87-96 and accompanying footnotes.

[18] *See, e.g.*, J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L. REV. 424 (2010).

[19] *See* discussion *infra* at 95-96 and accompanying footnotes.

deter future investment and upset investments already made. However, when implemented effectively, adaptive and collaborative management trades the façade of certainty in traditional management for actual knowledge derived from learning in the management process. Collaboration and adaptation can therefore create greater certainty for resource users, though it takes time to arrive at that increased understanding. That interim learning period may be a point of inevitable uncertainty.

The failures in implementation efforts thus far show that agencies have failed in the first instance to consider whether collaboration and adaptation are appropriate for a given management problem. Agencies have then gone on to inadequately design and implement and collaborative and adaptive processes. Agencies thus need to consider more thoroughly the helpfulness of collaborative and adaptive management for individual management problems, and to explain more clearly and completely how collaboration and adaptation will proceed in each instance. Further, agencies must be held to account for both the rationality of the threshold decision to employ collaborative and adaptive management and to design adequately and carry out effectively the processes.

Federal land managers are most well-equipped to serve as a hub for deploying collaborative and adaptive principles in wildlife management because they oversee a vast array of wildlife habitat, and already have established processes, as well as statutory authority, well-suited to collaboration and adaptation. To avoid the failures of past efforts to manage collaboratively and adaptively, federal land managers should in each instance require (1) front-end assessment of the propriety of adaptive and collaborative methods, (2) incorporation of minimum necessary components of collaboration and adaptation, and (3) implementation of the processes as planned.

New legislation could force the federal land managers to implement collaborative and adaptive management more effectively. However, such an approach might be neither attainable nor appropriate. Instead, land managers can take advantage of the opportunities already available to them—in planning, environmental assessment, and in site-specific actions—to plan adequately and commit to implementing collaborative and adaptive processes. Those commitments can, in turn, increase agency accountability. Such an effort to move collaborative and adaptive management beyond the mistakes of the past could not only prove beneficial to wildlife, but also increase understanding of the alternative governance techniques that will be necessary to manage human relations with a rapidly changing natural world.

Part II begins by examining wildlife in the United States, and the complex systems that wild creatures inhabit.[20] Part III then explains U.S. wildlife management, focusing on its historical origins in hunting, recent movements toward biodiversity conservation, and the fragmentation that

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[20] *See infra* at 10.

defines the field.[21] Next, Part IV shows how a changing climate will dramatically reshape life in the wild, and how current management institutions are ill-equipped to deal with the problems of fragmentation and scientific uncertainty that climate change will exacerbate.[22] Part V then discusses the contours of adaptive management and collaborative governance, explaining their theoretical appeal in a changing climate, as well as how both have failed to live up to their promises in practice.[23]

Finally, Part VI argues that federal land managers should serve as the hub for deploying collaborative and adaptive wildlife management. Part VI accordingly explains the suitability of wildlife management in general, and federal land management agencies in particular, to collaborative and adaptive methods, and sets forth specific substantive requirements designed to encourage successful implementation, facilitate accountability, and incentivize experimentation in collaborative and adaptive resource management.[24]

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[21] *See infra* at 19.
[22] *See infra* at 51.
[23] *See infra* at 79.
[24] *See infra* at 101.

II. WILDLIFE IN THE UNITED STATES

Within the United States resides an abundance of wildlife.[1] The wild inhabitants of the United States include broadly recognized charismatic mega fauna, such as the grizzly bear and rocky mountain elk, in addition to the less well-known, humbler creatures of the wild world, including the American pika and black-footed ferret. These wild creatures create tremendous economic value in the United States.[2] In 2006 alone, 71 million Americans spent more than $45 billion on wildlife-based recreation.[3] 2006 wildlife recreation expenditures accounted for one out of every $100 spent on goods and services in the United States.[4] That amount is roughly equivalent to total 2006 U.S. expenditures on all spectator sports, casinos, motion pictures, golf courses, country clubs, amusement parks, and arcades combined.[5] These expenditures resulted in more than $120 billion in industry

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[1] More than 400 species of mammals, 800 species of birds, 280 species of reptiles, 230 species of amphibians, and 800 species of fish call the United States home. *See* National Wildlife Federation, Wildlife Library, http://www.nwf.org/Wildlife/Wildlife-Library/Mammals.aspx (last visited Jan. 5, 2012).

[2] MICHAEL J. MANFREDO, WHO CARES ABOUT WILDLIFE? 2-5 (2008).

[3] JERRY LEONARD, WILDLIFE WATCHING IN THE U.S.: THE ECONOMIC IMPACTS ON NATIONAL AND STATE ECONOMIES IN 2006, at 3 (U.S. Fish & Wildlife Svc. report 2006-1, 2008).

[4] *U.S. Wildlife Recreation Spending Matches All Other Fun*, ENVT. NEWS SVC., June 20, 2007 (quoting Jerry Leonard, U.S. Fish & Wildlife Service survey economist), *available at* http://www.ens-newswire.com/ens/jun2007/2007-06-20-03.html.

[5] *Id.*

output, supporting more than 1 million jobs.[6]

Since settlement, North American wildlife has been a valuable resource for human uses. Early settlers valued the wild animals of North America primarily for utilitarian reasons, namely food and trade.[7] However, as human populations and demands on wildlife grew, use levels became unsustainable and the resource depleted.[8] In response, conservationists focused on limiting human use by managing wildlife for sustainable yields, with according legal protections for wildlife and habitat, helping to preserve much of what remained of U.S. wildlife.[9]

Support for this hunting-oriented model of managing wildlife has weakened over time as people have become less dependent on wildlife for food and trade and in turn have come to appreciate different values in wildlife.[10] For example, humans value the integral roles that wild animals play in the ecosystems that provide important services to human society.[11] Humans also value wildlife for scientific, aesthetic, and moral reasons, among others.[12]

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[6] LEONARD, *supra* note 3, at 4, 7.

[7] KEVIN H. DEAL, WILDLIFE AND NATURAL RESOURCE MANAGEMENT 20 (3d ed. 2011); MANFREDO, *supra* note 2, at 8.

[8] DAVID W. WILLIS, CHARLES G. SCALET, & ESTER D. FLAKE, INTRODUCTION TO WILDLIFE AND FISHERIES: AN INTEGRATED APPROACH 346 (2009); MANFREDO, *supra* note X. Technological advances, such as the advent of the repeating rifle, played a significant role in wildlife population depletion. *Id.*

[9] MANFREDO, *supra* note 2, at 8.

[10] John Fraser et al., *Understanding Global Values Toward Wildlife*, *in* WILDLIFE AND SOCIETY: THE SCIENCE OF HUMAN DIMENSIONS 31, 40 (Michael J. Manfredo et al. eds. 2009).

[11] *See, e.g.*, ROBERT A. SMALL & DAVID J. LEWIS, FOREST LAND CONVERSION, ECOSYSTEM SERVICES, AND ECONOMIC ISSUES FOR POLICY 15 (U.S. Dep't Ag. 2009) (noting that "wildlife often serve to pollinate plants, disperse seeds, and control pest populations").

[12] STEPHEN R. KELLERT, THE VALUE OF LIFE: BIOLOGICAL DIVERSITY AND HUMAN SOCIETY 38 (1996); *see also* Lori M. Hunter & Joan M. Brehm, *A Qualitative Examination of*

Increasing recognition of these "existence" values of wildlife has been correlated to declining hunting participation and increased stakeholder conflict in the traditional model of wildlife management.[13] These shifts in social values, as well as the increasing costs of managing wildlife, have hampered state wildlife management budgets.[14]

The varied benefits people enjoy from the use and existence of wildlife are widely distributed among the states.[15] The wild animals inhabiting the United States occupy a diverse range of geographic settings, from the swamps of the Everglades to the peaks of the Rocky Mountains, suburban backyards[16] to the concrete jungles of urban America.[17] It is not by chance that wild creatures call these places home. Rather, each species finds the conditions necessary for survival, such as food, water, and cover, in its habitat. Habitat conditions and, therefore, wildlife constantly evolve in response to both natural and manmade processes.

Value Orientations Toward Wildlife and Biodiversity by Rural Residents of the Intermountain Region, 11 HUMAN ECOLOGY REV. 13, 14 (2004).

[13] Michael J. Manfredo, Tara L. Teel, & Alan D. Bright, *Why Are Public Values Toward Wildlife Changing?*, 8 HUMAN DIMENSIONS OF WILDLIFE 287, 288 (2003).

[14] *See, e.g.*, *Number of Hunters in U.S. Declining*, CBSNEWS.COM, Feb. 11, 2009, http://www.cbsnews.com/2100-201_162-3228893.html; Oren Dorell, *American Hunter Is a Vanishing Breed*, USA TODAY, Oct. 23, 2007, http://usatoday30.usatoday.com/news/nation/2007-10-22-Hunter_N.htm?csp=1.

[15] Manfredo, Teel, & Bright, *supra* note 13, at 9, Table 5.

[16] *See generally* STEPHEN DESTEFANO, COYOTE AT THE KITCHEN DOOR: LIVING WITH WILDLIFE IN SUBURBIA (2010).

[17] *See generally* LOWELL W. ADAMS, URBAN WILDLIFE HABITATS: A LANDSCAPE PERSPECTIVE (1994).

Habitat

An animal's habitat is where it lives, the place it calls "home."[18] Habitat is often understood generally as a natural setting in relation to a particular species, such as forests for deer; cold, running water for trout; or swamps and marshes for ducks and geese.[19] An animal's habitat, however, consists of more than just these generally perceived natural environments.

A particular area, such as a forest, can provide habitat for a species, such as deer, only if the resources essential to survival—food, water, and cover—are present, and the animal has adapted to external pressures existing in the area, such as weather and predators.[20] Wildlife habitat must accordingly be understood as:

> an area with a combination of resources (like food, cover, water) and environmental conditions (temperature, precipitation, presence or absence of predators and competitors) that promotes occupancy by individuals in a given species (or population) and allows those individuals to survive and reproduce.[21]

The location of suitable habitat dictates an animal's geographic place in the natural world.[22] An animal's habitat is therefore much broader than a particular natural setting, such as a forest or marsh, encompassing instead "all the factors affecting an animal's chance to survive and reproduce in a

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[18] MICHAEL L. MORRISON, BRUCE G. MARCOT, & R. WILLIAM MANNAN, WILDLIFE-HABITAT RELATIONSHIPS: CONCEPTS AND APPLICATIONS 3 (3rd ed. 2006); DAVID R. PATTON, FOREST WILDLIFE ECOLOGY AND HABITAT MANAGEMENT 7 (2011).

[19] PATTON, *supra* note 18, at 8.

[20] MORRISON ET AL., *supra* note 18, at 3.

[21] *Id.* at 10.

[22] *Id.* at 4-5.

specific place."[23] The quality of a particular setting as wildlife habitat is accordingly a function of the survival and reproduction rates of species inhabiting the place, offspring vitality, and the duration of time the place is suitable for occupancy.[24]

Water and vegetation are the critical components of wildlife habitat[25] because all animals depend for survival on access to water and food.[26] Herbivores consume plants, and carnivores consume herbivores.[27] Plants are dependent on energy from the sun and nutrients from soil, air, and water.[28] These foundational communities change over time, in response to changing climatic conditions.[29] As plant communities evolve, so too do animal communities change.[30] In short, wildlife habitats are not static systems.[31]

The ability of a species to adapt to changes in habitat depends on the species' pre-adaptations to change and its ability to develop new adaptations.[32] In this way, habitat conditions naturally select animal traits best fitted to the natural environment.[33] When an animal cannot adapt to habitat changes, it must seek out new, suitable habitat to survive. Changing

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[23] PATTON, *supra* note 18, at 7.

[24] MORRISON ET AL., *supra* note 18, at 10; PATTON, *supra* note 18, at 9.

[25] MORRISON ET AL., *supra* note 18, at 10

[26] PATTON, *supra* note 18, at 2

[27] F. STUART CHAPIN, III, PAMELA A. MATSON, & PETER M. VITOUSEK, PRINCIPLES OF TERRESTRIAL ECOSYSTEM ECOLOGY 5 (2d. ed. 2011).

[28] PATTON, *supra* note 18, at 2

[29] *Id.* at 2.

[30] *Id.*

[31] *Id.* at 1.

[32] MORRISON ET AL., *supra* note 18, at 15.

[33] CHARLES DARWIN, THE ORIGIN OF SPECIES 93-144 (Charles W. Eliot ed., 1909).

habitat conditions thus result in the redistribution of animals seeking new habitat,[34] and the disappearance of those that fail to do so.[35]

Ecosystems

The habitat an animal occupies exists within a broader system of life. The ecosystem, of which a species is but one component, consists of all of the organisms and the particular abiotic environment interacting as an integrated system.[36] The biotic components of an ecosystem—the flora and fauna—interact with each other and with the environment, giving each ecosystem its unique characteristics.[37] Though ecosystems can tend toward equilibrium states,[38] change and surprise are nonetheless the essence of natural systems.[39] Ecosystems will frequently absorb small changes, but the wrong small change, or too many small changes combined, can throw the switch, sending the ecosystem into a significantly different state.[40] In this

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[34] MORRISON ET AL., *supra* note 18, 19-27. The North American vertebrate fossil record from the Pleistocene era "indicates movements of considerable magnitude in response to changing temperatures and moisture regimes during glacial advances and retreats." *Id.* at 27.

[35] Chris D. Thomas et al., *Extinction Risk from Climate Change*, 427 NATURE 145, 145 (2004), *available at* http://eprints.whiterose.ac.uk/83/1/ thomascd1.pdf.

[36] CHAPIN ET AL., *supra* note 27, at 5; ANTHON R.E. SINCLAIR, JOHN M. FRYXELL, & GRAEME CAUGHLEY, WILDLIFE ECOLOGY, CONSERVATION, AND MANAGEMENT 11 (2d ed. 2006); WILLIS ET AL., *supra* note 8, at 22.

[37] CHAPIN ET AL., *supra* note 27, at 5; SINCLAIR ET AL., *supra* note 36, at 11; WILLIS ET AL., *supra* note 8, at 23.

[38] ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT 9 (C.S. Holling ed. (1978) [hereinafter "HOLLING"].

[39] PANEL ON ADAPTIVE MANAGEMENT FOR RESOURCE STEWARDSHIP, ADAPTIVE MANAGEMENT FOR WATER RESOURCE PROJECT PLANNING 15 (Nat'l Academies Press 2004) [hereinafter AM FOR RESOURCE STEWARDSHIP].

[40] *Id.*; HOLLING, *supra* note 38, at 9, 31.

way, ecosystems, like habitats and species, are constantly tested for their ability to adapt to changing conditions.[41]

Each ecosystem, in turn, is part of a broader biome, into which regions can be classified based upon geography, rainfall, and mean annual temperature.[42] Biomes within the United States include broad natural settings such as deserts, forests, and grasslands often mistakenly conceived of as habitat.[43] The ecosystems that occupy these biomes are the primary functional units of the living world.[44]

At the core of ecosystem interactions among species and the environment is the transfer of energy.[45] These interactions, or exchanges of energy, constitute the relationships that define ecosystems.[46] Early studies assumed that these processes were largely contained, and that ecosystems were closed and dominated by internal recycling of elements.[47] Ecosystems were perceived to be self-regulating and deterministic, with external influences absent from stable cycles.[48] This equilibrium view of ecosystems has proven misguided.

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[41] HOLLING, *supra* note 38, at 34.

[42] SINCLAIR ET AL., *supra* note 36, at 11; Terry L. Root & Stephen H. Schneider, *Climate Change: Overview and Implications for Wildlife*, *in* WILDLIFE RESPONSES TO CLIMATE CHANGE 1, 19 (Stephen H. Schneider & Terry L. Root eds., 2002).

[43] SINCLAIR ET AL., *supra* note 36, at 11.

[44] SINCLAIR ET AL., *supra* note 36, at 11.

[45] CHAPIN ET AL., *supra* note 27, at 5.

[46] CHAPIN ET AL., *supra* note 27, at 3.

[47] CHAPIN ET AL., *supra* note 27, at 7.

[48] CHAPIN ET AL., *supra* note 27, at 7.

Ecosystems are in fact highly dynamic, having no single stable state.[49] Viewed from a nonequilibrium perspective, ecosystems have unbalanced inputs and losses and internal and external influences.[50] Human activities, for example, pervasively influence ecosystems, and those human influences themselves frequently change.[51] Although disturbance is a natural condition of the ecosystems animals inhabit, ecosystems can nonetheless achieve a relatively steady state of balanced inputs and losses over time.[52] The resilience of an ecosystem—its ability to absorb disturbance—is a function of biodiversity, the processes that structure the ecosystem, and sources of ecological renewal and reformation.[53]

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[49] CHAPIN ET AL., *supra* note 27, at 7.
[50] CHAPIN ET AL., *supra* note 27, at 7.
[51] CHAPIN ET AL., *supra* note 27, at 7.
[52] CHAPIN ET AL., *supra* note 27, at 7; *see also* HOLLING, *supra* note 38, at 9.
[53] *See generally* Lance H. Gunderson, *Ecological Resilience—In Theory and Application*, 31 ANN. REV. ECOL. SYST. 425 (2000).

III. U.S. WILDLIFE MANAGEMENT

The product of ironic origins, wildlife management in the United States is publicly oriented and widely fragmented. The U.S. model of wildlife management—often referred to as the North American Model—developed in response to the decimation of wildlife populations in the early years of North American settlement. For many years, the U.S. model focused primarily on maintaining sustainable yields of species for recreational hunting and fishing. In recent decades, however, increasing understanding of ecology has led to an expansion of wildlife management objectives to include, for example, conserving biological diversity and ecosystem services.

Both states and the federal government play significant roles in wildlife management. The federal government oversees vast systems of wildlife habitat, protects particular wildlife species, and assesses impacts federal actions have on wildlife. States fill the remainder of the field, though with substantial assistance from the federal government, primarily by regulating hunting and fishing.

The North American Model

At the core of wildlife management in the United States is the North American model of conservation. Born in response to the devastatingly excessive harvests of wildlife in the 18th and 19th centuries, the North American model is a publicly oriented, science-based approach to managing wildlife for the purpose of providing sustainable hunting and fishing harvests. The North American model traces its roots to settlement of the New World, where European immigrants encountered vast quantities of wildlife. Unlike in the Old World, where the landed gentry often controlled wild animals,[1] the wild creatures of North America were "there for the taking."[2] As a result, fur traders and meat hunters set out harvesting wildlife in numbers not easily sustained.

Early on, hunters concentrated their efforts on the eastern coast of the United States, with marked success.[3] Westward expansion created new opportunities. Prior to European settlement, as many as 30 million bison inhabited the Great Plains.[4] Weighing up to a ton and covered in thick fur,[5] the great bison herds were a lucrative resource for fur traders and meat

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[1] ERIC T. FREYFOGLE & DALE D. GOBLE, WILDLIFE LAW: A PRIMER 11 (2009). In England, for example, the right of landowners to exclude others precluded the possibility of hunting, because wildlife was concentrated on privately owned lands. *Id.*

[2] *Id.* at 123.

[3] Robert Brown, *A Conservation Timeline*, WILDLIFE PROFESSIONAL, Fall 2010, at 28, 28.

[4] Henry Epp & Ian Dyck, *Early Human-Bison Population Interdependence in the Plains Ecosystem*, 12 GREAT PLAINS RESEARCH 323, 330 (2002); *see also* Defenders of Wildlife, Basic Facts About Bison, http://www.defenders.org/bison/basic-facts (last visited Apr. 13, 2012).

[5] Joel Asaph Allen, *History of the American Bison,* Bison Americanus, *in* NINTH ANNUAL REPORT OF THE U.S. GEOLOGICAL SURVEY, FOR THE YEAR 1875, at 443, 446 (1877).

hunters eager to feed growing market demands in the United States and abroad. The American Fur Company, which all but monopolized the U.S. fur trade,[6] led the exploitation of the bison herds. In 1832, a single American Fur Company delivery to St. Louis included ten thousand pounds of buffalo tongues.[7] The following year, the American Fur Company shipped 43,000 bison hides to Europe.[8] By 1840, U.S. fur traders were selling 100,000 bison hides per year.[9] These harvests would pale in comparison to those that followed.

The completion of the transcontinental railroad in the 1860s opened the markets to the vast wildlife resources of the central United States, including the bison herds.[10] With the ease of railroad shipment available to the fur traders and meat hunters, mass shipment of bison products to growing U.S. urban centers and abroad became economical.[11] At the same time, the railroads served as easy transportation for more hunters to access the herds.[12] In turn, bison harvests grew exponentially: in 1865, 1 million bison killed; in 1871, 5 million.[13] Because the harvests far exceeded population replenishment, shipments of bison products eventually

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[6] HIRAM MARTIN CHITTENDEN, THE AMERICAN FUR TRADE OF THE FAR WEST 344-74 (1909).

[7] *Id.* at 340.

[8] Brown, *supra* note 3, at 28.

[9] ANDREW C. ISENBERG, THE DESTRUCTION OF THE BISON 93-94 (2000).

[10] *Id.* at 140; MARK V. BARROW, JR., NATURE'S GHOSTS: CONFRONTING EXTINCTION FROM THE AGE OF JEFFERSON TO THE AGE OF ECOLOGY 122 (2009); Brown, *supra* note 3, at 29.

[11] Brown, *supra* note 3, at 29.

[12] BARROW, *supra* note X, at 122; WILLIAM T. HORNADAY, THE EXTERMINATION OF THE AMERICAN BISON 491-93 (1889).

[13] Brown, *supra* note 3, at 29.

dwindled.[14] By 1890, the bison population, which once numbered in the millions, had been reduced to approximately 1,000 animals in a matter of mere decades.[15]

Other animals suffered similar fates. People hunted beavers, like buffalo, nearly to extinction for their fur.[16] The passenger pigeon, once the most abundant bird on the planet, was wiped out,[17] the last member of the species dying in captivity in 1914.[18] Predators were likewise pushed to the brink not only for fur and sport, but also because they preyed on livestock and species valued for hunting.[19] Humans exterminated the grizzly bear in all but two percent of its historical range in the continental United States.[20] Wolves, which once roamed most if not all of the lower forty-eight states,

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[14] ISENBERG, *supra* note 9, at 140; HORNADAY, *supra* note 12, at 498-501.

[15] ROBERT STEELQUIST, FIELD GUIDE TO THE NORTH AMERICAN BISON 10-11 (1998). One-fourth of the remaining bison were in captivity; one-fourth roaming wild in the United States; and one-half in Canada. HORNADAY, *supra* note 12, at 525. In 1886, Captain Moses Harris famously led fifty members of the U.S. Cavalry into Yellowstone to halt the pillaging of the park's resources. *See* ERIN H. TURNER, IT HAPPENED IN YELLOWSTONE 38-39 (2001); RICHARD A. BARTLETT, YELLOWSTONE: A WILDERNESS BESIEGED 257-59 (1989).

[16] ISENBERG, *supra* note 9, at 94; DAVID J. WISHART, THE FUR TRADE OF THE AMERICAN WEST, 1807-1840, at 35 (1979).

[17] G. TYLER MILLER & SCOTT E. SPOOLMAN, ENVIRONMENTAL SCIENCE 155 (2010). Mass deforestation also likely played a significant role in the extinction of the passenger pigeon. JULIAN P. HUME & MICHAEL WALTERS, EXTINCT BIRDS 145 (2012); Christopher W. Petersen & Don R. Levitan, *The Allee Effect: A Barrier to Recovery by Exploited Species*, *in* CONSERVATION OF EXPLOITED SPECIES 281, 285 (John D. Reynolds et al., eds., 2001)

[18] HUME & WALTERS, *supra* note 17, at 145. In 1878, one pigeon hunter alone allegedly killed 3 million birds. MILLER & SPOOLMAN, *supra* note 17, at 155.

[19] *See, e.g.*, R. Bruce Gill, *To Save a Mountain Lion: Evolving Philosophy of Nature and Cougars*, *in* COUGAR: ECOLOGY AND CONSERVATION 12 (Maurice Hornocker & Sharon Negri eds., 2010) (detailing efforts to exterminate cougars).

[20] Charles C. Schwartz, Sterling D. Miller, & Mark A. Haroldson, *Grizzly Bear* (Ursus arctos), *in* WILD MAMMALS OF NORTH AMERICA: BIOLOGY, MANAGEMENT, AND CONSERVATION 558 (George A. Feldhamer et al. eds. 2d. ed. 2003).

disappeared except for in the northernmost reaches of Minnesota.[21]

While government hunters and bounties drove the decimation of North American predators,[22] the extirpation of nonpredator wildlife can largely be attributed to the rule-of-capture explained in *Pierson v. Post*.[23] As Professors Goble and Freyfogle explain, *Pierson v. Post* treated wildlife as "property-by-capture with a classic starkness," allowing people to take natural capital—a wild animal—and convert it into dollars,[24] for example by selling its fur.[25] This led to the "law of the rush," awarding property rights in wild animals to the first person able to remove wild creatures from their natural state.[26] This first-in-time, first-in-right rule, coupled with the opportunity to convert natural capital into personal income, led to wildlife harvests wherever wildlife could supply a human demand.[27]

In response to the market failure that followed the rule of capture, the North American model of conservation evolved, beginning with the work of

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[21] Luigi Boitani, *Wolf Conservation and Recovery*, *in* WOLVES: BEHAVIOR, ECOLOGY, AND CONSERVATION 320-21 (L. David Mech & Luigi Boitani eds. 2003). Humans extirpated the cougar from 50% of its original range. R. Bruce Gill, *To Save a Mountain Lion: Evolving Philosophy of Nature and Cougars*, *in* COUGAR ECOLOGY & CONSERVATION 9 (Maurice Hornocker & Sharon Negri eds. 2010)

[22] *See, e.g.*, BRUCE HAMPTON, THE GREAT AMERICAN WOLF 135 (1997) (describing government hunter efforts); Diana Hadley, *Grazing the Southwest Borderlands: The Peloncillo-Animas District of the Coronado National Forest in Arizona and New Mexico, 1906-1996*, *in* FORESTS UNDER FIRE: A CENTURY OF ECOSYSTEM MISMANAGEMENT IN THE SOUTHWEST 93, 113 (Christopher J. Huggard & Arthur R. Gomez eds., 2001) (describing role of bounties in predator extermination efforts).

[23] 3 Caines 175 (N.Y. S. Ct. 1805); FREYFOGLE & GOBLE, *supra* note 1, at 123 (describing *Pierson* as providing "the basis for the claims of private property in wildlife that so shaped the early history of the European conquest of this continent").

[24] FREYFOGLE & GOBLE, *supra* note 1, at 123, 125.

[25] The idea that one can acquire ownership in natural capital through labor traces at least to the late seventeenth century. *See* JOHN LOCKE, SECOND TREATISE ON GOVERNMENT, ch. V, § 27 (1690).

[26] FREYFOGLE & GOBLE, *supra* note 1, at 123, 125.

[27] FREYFOGLE & GOBLE, *supra* note 1, at 124.

Theodore Roosevelt and George Bird Grinnell, who together founded the Boone & Crockett Club,[28] and later Aldo Leopold, the forefather of professional wildlife management.[29] At its core, the model embraces seven key tenets: (1) wildlife is a public resource, (2) wildlife shall not be commercially sold, (3) wildlife resources shall be allocated by law, (4) wildlife may be killed only for legitimate purposes, (5) wildlife is an international resource, (6) science provides the basis for wildlife policy, and (7) wildlife policy shall be democratically chosen.[30]

As one commentator observed, the North American model is "a conservation approach with irony at its core—sparked by hunters' over-exploitation of wildlife, then crafted by hunters striving to save the resources their predecessors had nearly destroyed."[31] Though not without its critics,[32] the North American model is widely embraced by wildlife managers and conservationists.[33] Its seven core principles provide the bases for wildlife

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[28] DOUGLAS BRINKLEY, THE WILDERNESS WARRIOR: THEODORE ROOSEVELT AND THE CRUSADE FOR AMERICA 202 (2009); *see also Constitution of the Boone and Crockett Club*, *in* AMERICAN BIG-GAME HUNTING: THE BOOK OF THE BOONE AND CROCKETT CLUB 327, 340 (Theodore Roosevelt & George Bird Grinnell eds., 1893).

[29] Leopold is credited with creating the discipline of wildlife management with his book, *Game Management*, in 1933.

[30] *See, e.g.*, Shane Patrick Mahoney, *Recreational Hunting and Sustainable Wildlife Use in North America*, *in* RECREATIONAL HUNTING, CONSERVATION AND RURAL LIVELIHOODS 266, 268-69 (Barney Dickson et al. eds., 2009); John F. Organ et al., *Born in the Hands of Hunters: The North American Model of Wildlife Conservation*, WILDLIFE PROFESSIONAL, Fall 2010, at 22, 25-27.

[31] Organ et al., *supra* note 30, at 22.

[32] *See* Michael P. Nelson et al., *North American Model: An Inadequate Construct?*, WILDLIFE PROFESSIONAL, Summer 2011, at 58. Nelson et al. criticize the model for being hunting-centric and that the emphasis on science ignores the inability of science to make value-oriented policy choices. *Id.*

[33] *See, e.g.*, Association of Fish & Wildlife Agencies, Investing in America's Conservation Legacy, http://www.fishwildlife.org/index.php?section=north_american_model_of_wildlife_conserv (describing the model as "the world's most successful")

management in the United States today.

Biodiversity Conservation

Premised on the scientific recognition that biological diversity increases ecosystem functions and strengthens ecological resilience, [34] conservation biology increasingly influences the traditionally narrow hunting-centric approach to wildlife management. Conservation biology values the diversity of life as a good in itself that should be conserved.[35] This view, which traces to Aldo Leopold's land ethic,[36] contrasts starkly with the North American Model's focus on managing particular hunted species of wildlife, which is prone to ignore broader ecosystem dynamics and nonuse values of wildlife.[37] While biodiversity conservation does not directly conflict with the hunting-centric North American model, it has historically been subservient to hunting oriented goals in wildlife management.[38] Because the North American Model that dominates wildlife management today traces its roots to hunting, and because hunting activities fund wildlife management

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(last visited Apr. 14, 2012); Rocky Mountain Elk Foundation, North American Wildlife Conservation Model, http://www.rmef.org/Hunting/HuntersConservation/ (last visited Apr. 14, 2012).

[34] Curt Meine, *Conservation Biology: Past and Present*, *in* CONSERVATION BIOLOGY FOR ALL 7, 14-15, 21 (Navjot S. Sodhi & Paul R. Ehrlich eds., 2010); also see generally EDWARD O. WILSON, THE DIVERSITY OF LIFE (1992).

[35] *Id.*

[36] Recognition of the intrinsic value of diversity was a central component of Aldo Leopold's land ethic. CURT D. MEINE, ALDO LEOPOLD: HIS LIFE AND WORK, at xxi, 404 (1988).

[37] For an explanation of nonuse wildlife values and ecological relationships, *see* discussion *supra* at 26-27 and accompanying footnotes.

[38] MALCOLM L. HUNTER, JR, & JAMES P. GIBBS, FUNDAMENTALS OF CONSERVATION BIOLOGY 20 (3d ed. 2007).

activities,[39] biodiversity conservation has remained only a secondary goal to the traditional emphasis on maintaining sustainable hunting harvests.[40]

Management Law

States and the federal government today manage wildlife according to a fragmented array of legal mandates built around the North American model. Some laws focus on particular species or families of wildlife, while others primarily concern management of land that often serves as wildlife habitat. States predominantly control wildlife, and do so primarily through the regulation of wildlife harvests. For the most part, state wildlife law consists of a regulated form of the rule-of-capture. Federal law, by contrast, sets forth substantial rules for particular wildlife species, while also exerting sizable influence on wildlife management through federal land and resource management law. The different origins and prerogatives of these disparate sources of law create a tangled web of overlapping legal systems in wildlife management.

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[39] The financial dependence of state wildlife management on hunting traces its roots to the Pittman-Robertson Act, which offered states federal funds on the condition that states reinvest hunting license revenues in wildlife resources. *See* 16 U.S.C. § 669; *see also* DAVID W. WILLIS, CHARLES G. SCARLET, & LESTER D. FLAKE, INTRODUCTION TO WILDLIFE AND FISHERIES 351-52 (2009) (describing the "carrot-and-stick" funding approach of Pittman-Robertson).

[40] Wildlife managers are increasingly focusing efforts on biodiversity conservation. HUNTER & GIBBS, *supra* note 38. Also see, for example, Oklahoma Dept. of Wildlife Conservation, Oklahoma's Biodiversity Plan: A Shared Vision for Conserving Our Natural Heritage, http://www.wildlifedepartment.com/wildlifemgmt/biodiversity.htm (last visited Sept. 4, 2012).

Nonetheless, federal land management law positions federal land managers as the loci for interaction among the disparate fields of land and wildlife law. For example, land managers must often account for state wildlife law in their planning documents,[41] and invite the participation of state and local interests in evaluating the impacts of proposed land manager actions.[42] The Endangered Species Act also plays a significant role, requiring federal land managers to consult with the Fish and Wildlife Service prior to taking actions likely to affect endangered species.[43]

Wildlife Law

The majority of wildlife law exists at the state level.[44] Federal wildlife law, which supplants conflicting state law,[45] plays only a partial direct role in wildlife, typically advancing one or several of three objectives: restricting harvests, protecting and managing habitat, and requiring federal agencies to account for the impacts of their actions on wildlife.[46]

At the core of all of U.S. wildlife law is the first principle of the North American model—that wildlife is a public resource. The states own wild animals "in trust for the people generally and with a duty to manage them for the benefit of the many[.]"[47] In this regard, public ownership of wildlife is

[41] *See infra* at XX.
[42] *See infra* at XX.
[43] *Id.* (a)(3).
[44] ERIC T. FREYFOGLE & DALE D. GOBLE, WILDLIFE LAW: A PRIMER 3 (2009).
[45] U.S. Const. art. VI, cl. 2.
[46] FREYFOGLE & GOBLE, *supra* note 1.
[47] FREYFOGLE & GOBLE, *supra* note 1, at 25.

unlike ownership of any other resource in the United States, save perhaps for certain water resources.[48]

State ownership of wildlife traces its origins to the laws of England. Under English common law, the crown owned and controlled wildlife, as well as the beds and banks of navigable waterways.[49] Early American courts understood royal control of navigable waterways to derive from the crown's sovereign authority.[50] As an incident of the sovereign authority transferred to the states from the crown, states were obligated to manage U.S. navigable waters for the benefit of the people.[51] Over the second half of the nineteenth century, U.S. courts gradually applied this concept of public trust ownership to wildlife.[52] Translating the proprietary and sovereign interests the crown had held in wildlife, courts reasoned "that the ownership of wild animals, so far as they are capable of ownership, is in the state, not as proprietor, but in its sovereign capacity, as the representative, and for the benefit, of all its people in common."[53]

Through regulation, states have thus far helped to avoid a replay of the tragic decimation of American wildlife that occurred in the 19th century. Unlike the rule-of-capture commercial free-for-all that dominated early

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[48] *See* WELLS A. HUTCHINS, WATER RIGHTS LAWS IN THE NINETEEN WESTERN STATES, Vol. 1, at 141 (U.S. Dept. Ag. 1971) (describing state ownership of the corpus of water)

[49] FREYFOGLE & GOBLE, *supra* note 1, at 100-13.

[50] *Arnold v. Mundy*, 6 N.J.L. 1 (N.J. 1821) (describing submerged tidelands as "the domain of the crown or the republic" and therefore "common property"); *Martin v. Waddell's Lessee*, 41 U.S. (16 Pet.) 367 (1842); *see also* FREYFOGLE & GOBLE, *supra* note 1, at 384-85.

[51] *Waddell's Lessee*, 41 U.S. at 413-14.

[52] FREYFOGLE & GOBLE, *supra* note 1, at 385.

[53] FREYFOGLE & GOBLE, *supra* note 1, at 385 (quoting *State v. Rodman*, 59 N.W. 1098 (Minn. 1894)).

American approaches to wildlife, states today conceive of wildlife management as "the art of making land produce *sustained* annual crops of wild game for recreational use."[54] In other words, states manage wildlife for the primary purpose of maintaining sustainable yields of species for hunters to harvest. States also manage wildlife for secondary purposes, such as conservation of biodiversity[55] and threatened species.[56]

The ironic origin of the North American model—a hunter-supported solution to a hunter-caused problem—has not been without consequences. State wildlife management agencies focused from the outset on "economically important" game species, selling hunting permits to fund agency activities.[57] Agencies have accordingly concentrated on the science of managing those species, largely ignoring the science of nongame wildlife.[58] Wildlife management for state game agencies has thus amounted to "encouraging

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[54] ALDO LEOPOLD, GAME MANAGEMENT 3 (1933) (emphasis added).

[55] *See, e.g.*, Washington State Recreation & Conservation Office, About the Washington Biodiversity Council, http://www.rco.wa.gov/biodiversity/about_the_council.shtml (last visited Sept. 4, 2012); Oklahoma Department of Wildlife Conservation, *supra* note 40.

[56] *See, e.g.*, OR. ADMIN. R. 635-100-040 (establishing "sensitive" species classifications); Wyo. Exec. Order no. 2011-5 (June 2, 2011) (establishing sage grouse protections).

[57] Richard L. Knight & Sarah F. Bates, *The Beginnings of Natural Resources Management*, *in* A NEW CENTURY FOR NATURAL RESOURCES MANAGEMENT 1, 1 (Richard L. Knight & Sarah F. Bates eds. 1995)

[58] *Id.* Concentrating on maintaining sustainable harvests of game species led state game agencies to eliminate natural predators, such as coyotes and cougars, without regard for what bigger ecological consequences might spillover from that action. For example, the removal of wolves from the Yellowstone ecosystem led to the unexpected consequence of declines in aspen tree populations. *See generally* William J. Ripple & Eric J. Larsen, *Historic Aspen Recruitment, Elk, and Wolves in Northern Yellowstone National Park, USA*, 95 BIOLOGICAL CONSERVATION 361 (2000). Despite the propensity for predator control to have unintended consequences, states continue to take this approach. *See, e.g.*, Utah Div. of Wildlife Resources, Utah's Predator Control Program (Sept. 25, 2012), http://wildlife.utah.gov/dwr/hunting/hunting-information/762.

desirable species to multiply and undesirable species to decline."[59] This policy is often evident in state efforts to eradicate predators for the purpose of boosting large game species, such as deer.[60] That narrow focus is a weakness because single species science cannot address broader issues of ecosystem well-being.[61] In a changing climate, with corollary evolving ecosystem dynamics, the weakness could cripple wildlife managers.

States allocate wildlife resources according to democratically enacted laws, typically governing hunting and trapping pursuant to licensing schemes that allow individuals to take specified numbers of particular species during established seasons with specific means.[62] States normally allow wildlife to be taken only for purposes recognized to be legitimate, such as the harvest of meat or fur, and typically prohibit commercial trade of game products.[63] Though wildlife managers idealistically proclaim science to guide state game agency decision-making in pursuit of harvest sustainability,

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[59] Stanley H. Anderson, *Traditional Approaches and Tools in Natural Resources Management*, *in* A NEW CENTURY FOR NATURAL RESOURCES MANAGEMENT, *supra* note 57, at 61, 70.

[60] *See, e.g.*, Lee Davidson, *Utah Senators Approve Hike in Bounty on Coyotes*, SALT LAKE TRIB., March 5, 2012, http://www.sltrib.com/sltrib/politics/53652213-90/act-approve-bill-bounty.html.csp.

[61] Conservation biology, with its emphasis on biodiversity conservation and ecosystem health, provides an alternative to single-species management. *See* discussion *infra* at 26-27 and accompanying footnotes.

[62] *See, e.g.*, NEV. REV. STAT. § 503.090 (prohibiting hunting except during established seasons); WASH. ADMIN. CODE § 232-28-358 (establishing harvest limits and hunting seasons). In some states, the hunting of some wild creatures, such as coyotes, is not regulated. In fact, some states even encourage the maximum harvest of particular species, which are deemed pests, with bounties. *See, e.g.*, UTAH CODE ANN. § 23-20-104 (providing compensation to individuals who kill predators of mule deer).

[63] *E.g.*, UTAH CODE ANN. § 23-13-13 (prohibiting utilization of wildlife "as a commercial venture for financial gain").

politics can often take precedent over science.[64]

Against this general backdrop of state wildlife laws, federal laws provide specific, overriding directives in narrow but influential contexts. Several of these federal laws help to fulfill specific principles of the North American model. For example, the Lacey Act[65] has for more than 100 hundred years embraced the principle that wildlife shall not be commercially traded.[66] In this way, the Lacey Act limits the range of economic incentives available to hunters to capitalize on the *Pierson v. Post* rule of capture.

The Migratory Bird Treaty Act,[67] the federal statute enacting a treaty by the same name between the United States and Canada,[68] as well as later treaties with Japan,[69] Mexico,[70] and the now dissolved Soviet Republic,[71] recognizes the principle that wildlife is an international resource.[72] Like the Lacey Act, the Migratory Bird Treaty Act can be understood as a limitation on the rule of capture, ensuring that signatories to the treaty will not operate as regulatory safe havens for the unrestricted harvest of migratory wildlife.

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[64] *See generally* Martin Nie, *State Wildlife Policy and Management: The Scope of Bias of Political Conflict*, 64 PUB. ADMIN. REV. 221 (2004). Politics often play a role in endangered species management. *See, e.g.*, MARTIN A. NIE, BEYOND WOLVES: THE POLITICS OF WOLF RECOVERY AND MANAGEMENT 26-66 (2003); Nicole Allan, *Endangered Species: The Environmental Issue for 2012*, ATLANTIC, June 28, 2011 (discussing political controversy surrounding wolf delisting), http://www.theatlantic.com/politics/archive/2011/06/endangered-species-the-environmental-issue-for-2012/241150/.

[65] 16 U.S.C. §§ 3371-3378 (2011).

[66] § 3372(a) (prohibiting commerce in wildlife that has been illegally taken, transported, or sold).

[67] §§ 703-712 (1918).

[68] Migratory Bird Treaty with Canada (1916).

[69] Migratory Bird Treaty with Japan (1974).

[70] Migratory Bird and Game Mammal Treaty with Mexico (1936).

[71] Migratory Bird Treaty with the Soviet Union (1978).

[72] 16 U.S.C. §§ 703(a), 704(a) (2011). The Act primarily prohibits the harvest and possession of migratory bird species.

While the Migratory Bird Treaty Act protects a class of wildlife, other federal laws safeguard particular species. The Bald and Golden Eagle Protection Act,[73] for example, prohibits any person from taking or possessing any eagle or part thereof without a permit from the Secretary of the Interior.[74] The Endangered Species Act,[75] by contrast, does not prohibit the harvest of named species, such as eagles, but rather protects an evolving collection of species designated under the Act as endangered by generally prohibiting harm to those species.[76] At present, nearly 1,300 U.S. animals receive protection under the Act.[77]

Federal wildlife laws also focus on interagency consultation to ensure avoidance of undue harm to wildlife. Section 7 of the Endangered Species Act, for example, requires federal agencies to consult with the U.S. Fish and Wildlife Service to ensure that agency actions will not jeopardize the continued survival of listed species, or modify critical habitat for protected species.[78] The National Environmental Policy Act provides a broader, though less stringent, protection for wildlife by requiring federal agencies to consider the impacts agency actions have on wildlife.[79]

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[73] §§ 668-668d.

[74] § 668(a). The Marine Mammal Protection Act provides similar protections for marine mammals, such as whales and seals. *See* 16 U.S.C. § 1371(a) (2011).

[75] §§ 1531-1544

[76] § 1538(a)(1) (frequently referred to as the Section 9 take prohibition).

[77] U.S. Fish & Wildlife Service, Species Reports, http://ecos.fws.gov/tess_public/pub/listedAnimals.jsp (Apr. 28, 2012).

[78] 16 U.S.C. § 1536(a)(2) (2011).

[79] 42 U.S.C. § 4332(c) (2011) (requiring federal agencies to assess environmental impacts of major actions).

Public Land Law

Management of the lands wild creatures inhabit inevitably implicates wildlife management.[80] Aldo Leopold famously recognized this fact, asserting that wildlife management is fundamentally about "making the *land* produce"[81] wildlife populations. The United States is the largest land manager in the nation, overseeing more than 600 million acres, or roughly 1 million square miles, of land within the country.[82] Federal land management law controls the national parks and forests, wilderness areas, wildlife refuges, and vast swaths of unreserved federal public lands. These lands provide habitat for thousands of species of wild animals. As a result, federal land management laws play an important though indirect role in wildlife management.[83]

In some cases, federal law directs that lands be managed for the dominant purpose of conservation, while in others, wildlife is but one of the multiple considerations that factors into land management decisions. Dominant-use federal lands managed for wildlife conservation include the national wildlife refuges, parks, and monuments, while lands managed for multiple-uses, of which wildlife is but one, include national forests and Bureau of Land Management properties. Specially designated segments of

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[80] Anderson, *supra* note 59.

[81] ALDO LEOPOLD, GAME MANAGEMENT 3 (1933, 1986).

[82] Ross W. Gorte et al., Federal Land Ownership: Overview and Data 16 (Cong. Res. Svc. Feb. 8, 2012), *available at* http://www.fas.org/sgp/crs/misc/R42346.pdf.

[83] ROBERT L. FISCHMAN, THE NATIONAL WILDLIFE REFUGES: COORDINATING A CONSERVATION SYSTEM THROUGH LAW 86 (2003) ("a fundamental axiom of wildlife management …[is] that animals and plants cannot be conserved without providing for their habitat.") (internal citations omitted).

land overlying both dominant and multiple-use lands—such as wilderness areas and wild and scenic rivers—restrict land use in a manner akin to dominant-use management, giving special management priorities to particular values.

This distinction between managing federal lands for a dominant purpose, such as wildlife preservation, versus multiple purposes, is central to understanding the way that federal land management law shapes wildlife management. The underlying philosophical tension between dominant and multiple-use management regimes is but an instance of the historic tension between use and preservation of nature. Multiple-use management law, like most wildlife management law, seeks utilitarian ends—to maximize benefits flowing from resource utilization. By contrast, dominant-use land management typically obligates the manager to pursue the dominant-use as a value in itself irrespective of benefit maximization. Thus, commitment to a particular value guides dominant-use management, while consequences (costs and benefits) drive multiple-use management. Dominant-use lands can accordingly serve as safe havens for wildlife, and may therefore be understood as conservation islands in a sea of lands subjected to multiple-uses, many of which can impact wildlife survival.

Each federal land management agency supervises habitat for hundreds of endangered species. Four hundred and twenty-two endangered and threatened species occupy Forest Services lands,[84] 412 survive on Park Service lands,[85] and 245 on Bureau of Land Management property.[86] Every action these agencies propose that could affect endangered species requires consultation with the Fish and Wildlife Service, in addition to appropriate measures to ensure the action does not jeopardize the listed species.

Dominant-Use Lands

Wildlife Refuges

The U.S. Fish and Wildlife Service oversees the National Wildlife Refuge System. The first wildlife refuge, Pelican Island, was established at the behest of Theodore Roosevelt in 1903.[87] Today, the refuge system is a "significant conservation network"[88] encompassing more than 150 million acres spread across 556 refuges.[89] The Fish and Wildlife Service operates the refuge system under a wildlife-friendly conservation mandate, which provides that:

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[84] U.S. Forest Service, Threatened and Endangered Species, http://www.fs.fed.us/biology/resources/pubs/tes/te_summary_08july08.pdf (July 8, 2008);

[85] U.S. National Park Service, 2010 Species Status Summary, http://nature.nps.gov/biology/endangeredspecies/assets/docs/SpeciesStatusSummary.pdf (Jan. 19, 2011).

[86] U.S. Bureau of Land Management, Threatened and Endangered Species Program, http://www.blm.gov/wo/st/en/prog/more/fish__wildlife_and/threatened.html (Aug. 27, 2010).

[87] Lynn A. Greenwalt, *A Brief History of the National Wildlife Refuge System*, *in* AMERICA'S NATIONAL WILDLIFE REFUGES 11, 14 (Russell D. Butcher ed. 2008); Robert H. Nelson, *The Federal Land Management Agencies*, *in* A NEW CENTURY FOR NATURAL RESOURCES MANAGEMENT, *supra* note 57, at 37, 50.

[88] FISCHMAN, *supra* note 83, at 24.

[89] U.S. Fish & Wildlife Service, National Wildlife Refuge System, http://www.fws.gov/refuges/about/welcome.html (Oct. 28, 2011). Fifty-nine of the refuges were established for the primary purpose of conserving endangered or threatened species. *Id.*

> The mission of the system is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. [90]

In pursuit of this broad conservation mission, the Fish and Wildlife Service must conserve fish, wildlife, plants, and their habitats within the system; maintain the biological integrity, diversity, and environmental health of the system; and monitor fish, wildlife, and plants.[91] The general conservation objectives of the refuge system are subservient to achieving the purposes for which each individual refuge was established.[92] In its management of the refuge system, the Service must cooperate and collaborate with landowners adjoining refuges, as well as federal and state agencies.[93]

The Fish and Wildlife Service must comprehensively plan for each unit within the refuge system,[94] and provide opportunities for public comment on refuge plans.[95] The plan must be consistent with the substantive refuge management mandates[96] and, to the extent practicable, with wildlife plans of the state in which the planning unit is located.[97] At least once every fifteen

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[90] 16 U.S.C. § 668dd(a)(2) (2011).

[91] § 668dd(a)(4)(A), (B). (N).

[92] § 668dd (a)(4)(D) (providing that in case of conflict, refuge mission prevails over system mission). As Professor Fischman observes, this preference for individual refuge purposes undermines systemic management of the refuges. FISCHMAN, *supra* note 83, at 80.

[93] 16 U.S.C. § 668dd(a)(4)(E), (M) (2011).

[94] § 668dd(e)(1)(A)(i).

[95] § 668dd(e)(1)(A)(ii).

[96] For example, conserving fish and wildlife and maintaining ecological integrity. *See* 16 U.S.C. § 668dd(a).

[97] § 668dd(e)(1)(A)(iii).

years, the Service must revise management plans as necessary.[98]

The general conservation mission notwithstanding, the wildlife refuge network consists of a “hodgepodge” assembly of lands.[99] Some refuges are smaller than an acre in size, while the largest is bigger than the state of Connecticut.[100] Still, the entire system is roughly the size of Montana.[101] Only wilderness areas, discussed below, set aside a larger land base for wildlife conservation.[102] In all, the wildlife refuge system provides a home to more than 700 species of birds, 220 species of mammals, 200 species of fish, and 250 species of reptiles and amphibians.[103] The wild animals calling the refuges home include more than 280 species listed as endangered or threatened under the Endangered Species Act.[104]

National Parks

Like the U.S. Fish and Wildlife Service, the National Park Service manages considerable acreages of federal lands for the dominant purpose of conservation. The National Park Service oversees roughly 84 million acres

[98] § 668dd(e)(1)(A)(iv).

[99] FISCHMAN, *supra* note 83, at 1. Professor Fischman describes the refuge system as a “crazy quilt,” consisting in a “tangle of land units with widely varying sizes, purposes, origins, ecosystems, climates, levels of development and use, and degrees of federal ownership and Service control.” *Id.* at 23. Yet, Professor Fischman notes, all of the refuge units nonetheless “share a general purpose of animal conservation.” *Id.*

[100] Greenwalt, *supra* note 87, at 13.

[101] Greenwalt, *supra* note 87, at 13.

[102] FISCHMAN, *supra* note 83, at 24.

[103] U.S. Fish & Wildlife Service, *supra* note 89.

[104] U.S. Fish & Wildlife Service, *supra* note 89.

scattered across nearly 400 hundred national parks[105] in forty-nine states and several territories, including more than 4.5 million acres of oceans, lakes, and reservoirs, as well as approximately 43,000 miles of perennial rivers and streams. [106] Four hundred endangered species call Park Service lands home.[107]

The National Park Service Organic Act expressly calls for wildlife conservation, directing the Park Service to manage national parks so "to conserve the scenery and the natural and historic objects and the wildlife therein…as will leave them unimpaired for future generations." [108] The statutes establishing individual parks have similar conservation goals.[109]

Unlike the Fish and Wildlife Service, the Park Service is not subject to a strict management planning process. Instead, the Park Service must prepare and revise "in a timely manner" general management plans that provide for preservation of park resources, descriptions of development associated with park use, commitments for visitor carrying capacities, and

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[105] U.S. National Park Service, About Us, http://www.nps.gov/aboutus/index.htm (Apr. 11, 2012).

[106] *Id.*; *see also* Robert B. Keiter, *The National Park System: Visions for Tomorrow*, 50 NAT. RESOURCES J. 70, 72 (2010).

[107] U.S. National Park Service, *supra* note 105.

[108] 16 U.S.C. § 1 (2011).

[109] See, for example, the North Cascades National Park Act, establishing the park "[i]n order to preserve for the benefit, use, and inspiration of present and future generations certain majestic mountain scenery, snow fields, glaciers, alpine meadows, and other unique natural features"), 16 U.S.C. § 90 (2011); Joshua Tree National Park Act, 16 U.S.C. § 410mm(a) (2011), seeking to protect "essential and superlative natural, ecological, archeological, paleontological, cultural, historical, and wilderness values" from "incompatible development and inconsistent management," *id.* § 410aaa-21. Other park establishment acts simply incorporate by reference the conservation mission of the organic act. *See, e.g.*, Olympic National Park Act, 16 U.S.C. § 254 (2011) (requiring park to be managed in accordance with 16 U.S.C. § 1).

potential modifications to park unit boundaries.[110] Similarly, the Park Service is not statutorily required to coordinate its planning and administration with state entities, unlike the other three primary federal land managers. Instead, the Park Service is authorized to cooperate its activities with other parties in only two limited instances: first, with states and other entities for the purpose of developing joint training and research programs focusing on national park resources;[111] and second, when a national park unit is located near or adjacent to a state park, the Service can enter into a cooperative management arrangement, though the Service cannot transfer management responsibilities under such an agreement.[112]

Just as the wildlife refuge system constitutes a "hodgepodge" of individual units, so too has the national park system been assembled "in a haphazard fashion, driven more by hard-headed political calculations and attractive scenic features than by a sweeping commitment to preserving diverse ecosystems or key biological specimens."[113] Haphazard as development of the park system may have been, the Organic Act's conservation mandate has led the national parks to be understood "as wildlife reserves."[114]

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[110] 16 U.S.C. § 1a-7(b) (2011).
[111] 16 U.S.C. § 1a(j) (2011).
[112] *Id.* § 1a(I)(1).
[113] Keiter, *supra* note 106, at 72, 77.
[114] Keiter, *supra* note 106, at 89, 90.

Multiple-Use Lands

Together, BLM and Forest Service lands account for half of a billion acres of the public domain, much of which serves as wildlife habitat. The Department of Interior, through the Bureau of Land Management, and the Department of Agriculture, through the Forest Service, manage land not primarily for conservation purposes, but rather for multiple-uses, such as recreation, mining, timber production, and livestock grazing, of which wildlife conservation is but one of many competing and sometimes conflicting management objectives.

Multiple-use, sustained-yield management is an essentially utilitarian method of administration—the greatest good for the greatest number[115]—which Gifford Pinchot is attributed with popularizing in United States natural resource management.[116] In seeking the greatest good, multiple-use management is generally "production-oriented"[117] and "inherently biased

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[115] *See, e.g.*, JEREMY BENTHAM, A FRAGMENT ON GOVERNMENT 93 (F.C. Montague ed., 1891) ("it is the greatest happiness of the greatest number that is the measure of right and wrong").

[116] *See, e.g.*, GERALD W. WILLIAMS, THE FOREST SERVICE: FIGHTING FOR PUBLIC LANDS 287 (2007) (noting Pinchot's influence directing the forest service toward "the greatest good" over the "long run"); *see also* George Cameron Coggins, *Of Succotash Syndromes and Vacuous Platitudes: The Meaning of "Multiple-use, Sustained Yield" for Public Land Management*, 53 U. COLO. L. REV. 229, 238 (1982). Pinchot first expressed this view in a letter he ghostwrote. *See* GIFFORD PINCHOT, BREAKING NEW GROUND 261-62 (1947). Pinchot's adoption of this philosophy ultimately owes to British forester Sir Dietrich Brandis. *See id.* at 17 (describing Brandis' influence and belief that forestry "is simply one means to the general good"); *see also* George Cameron Coggins, *The Law of Public Rangeland Management IV: FLPMA, PRIA, and the Multiple-use Mandate*, 14 ENVTL. L. 1, 34 (1983).

[117] Sandra Zellmer & Lance Gunderson, *Resilience May Not Always Be a Good Thing: Lessons in Ecosystem Restoration from Glen Canyon and the Everglades*, 87 NEB. L. REV. 893, 903 (2009).

towards commodity users."[118]

National Forests

The Forest Service—the slightly smaller but significantly older of the two federal multiple-use land managers—oversees roughly 225 million acres of national forests and 4 million acres of national grasslands[119] that provide crucial wildlife habitat.[120]

Congress established the Forest Service in 1905 to manage the growing stock of forestlands reserved to the United States. Following the mandate of its 1897 organic act, in the early years, the Forest Service focused on maintaining sustainable timber supplies and protecting watersheds.[121] Then, with the passage of the Multiple-Use, Sustained-Yield Act,[122] the Forest Service's management mandate expanded to include not only timber production and watershed protection, but also wildlife and recreational

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[118] Michael C. Blumm, *Public Choice Theory and the Public Lands: Why "Multiple-use" Failed*, 18 HARV. ENVTL. L. REV. 405, 415, 429 (1994). Critics of BLM have thus referred to the agency as the "Bureau of Livestock and Mining," a critique credited to Edward Abbey. *See* Scott Willoughby, *Christo Goes "Over" the Top with Arkansas River Project*, DENVER POST, Feb. 8, 2012, http://www.denverpost.com/willoughby/ci_19895852; Matt Kelley, *Bureau of Land Management Is Placing Emphasis on Conservation*, L.A. TIMES, Nov. 21, 1999, http://articles.latimes.com/1999/nov/21/local/me-36521. In its preference for extractive values in nature, federal multiple-use land law is similar to state wildlife management law.

[119] U.S. Dep't Agriculture, Forest Svc., Land Areas of the National Forest System 1, Table 1 (Sept. 30, 2011), *available at* http://www.fs.fed.us/land/staff/lar/LAR2011/LAR2011_Book_A5.pdf.

[120] *See, e.g.*, U.S. Forest Svc., Medicine Bow National Forest Revised Land and Resource Management Plan, Final Environmental Impact Statement, Appendix D Biological Diversity Report at D-15 (Dec. 2003), *available at* http://www.fs.usda.gov/detail/mbr/landmanagement/planning/?cid=fsbdev3_025109; U.S. Forest Svc., Thunder Basin National Grassland Land and Resource Management Plant 3-469 to 3-480 (2001), *available at* http://www.fs.usda.gov/detail/mbr/landmanagement/planning/?cid=fsbdev3_025111.

[121] 30 Stat. 32-36 (1897).

[122] 16 U.S.C. §§ 528-31 (2011).

values.[123] Under the National Forest Management Act, the Service must consider "the economic and environmental aspects"[124] of wildlife management and "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives."[125] As with some parks and refuges, some forests were reserved for specific management goals that must also be accounted for in the management process.[126]

The National Forest Management Act[127] guides the Forest Service's fulfillment of the multiple-use, sustained yield mandate. It requires the Service systematically to prepare and maintain interdisciplinary resource management plans for forest system units that must coordinate with the resource management planning of other federal agencies and state and local governments.[128] Opportunities for public comment and a public hearing are required components of the process.[129] After adoption, forest management plans serve as the overarching framework for all activity that occurs within forest planning units.[130] Like the Fish and Wildlife Service, the Forest

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[123] § 528; *see also* HAROLD K. STEEN, THE U.S. FOREST SERVICE: A HISTORY 297-308 (1970) (describing origins and implementation of multiple-use in the national forest system).

[124] 16 U.S.C. § 1604(g)(3)(A) (2011).

[125] *Id.* § 1604(g)(3)(B).

[126] *E.g.*, 16 U.S.C. § 494 (2011) (Forest Service "shall administer… to prolong the existence, growth, and promote the reproduction of said big trees.")

[127] 16 U.S.C. §§ 1600-1614 (2011).

[128] § 1604(a), (b). The plans must consider physical, biological, economic, and other sciences," § 1604(b), and "be prepared by an interdisciplinary team," *id.* at (f)(3).

[129] § 1604(d), (f)(5)(B).

[130] § 1604(i).

Service must revise its plans at least every fifteen years.[131]

Unreserved Lands

BLM manages the vast unreserved public domain, 247.5 million surface acres of land,[132] of which nearly 175 million acres serve as habitat[133] for more than 3,000 wildlife species.[134] BLM lands are the remains of the federal domain not granted to states or railroads, disposed through homestead or mining laws, or reserved for other purposes, such as national parks or forests.[135]

The Federal Land Policy and Management Act (FLPMA)[136] directs BLM to manage these lands, like the national forests, for sustained yields of multiple-uses.[137] In fulfilling its multiple-use management mandate, BLM is required to manage lands "in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values[.]"[138]

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[131] § 1604(f)(5)(A).

[132] U.S. DEP'T OF INTERIOR, BUREAU OF LAND MGMT., PUBLIC LAND STATISTICS 2011, at 1 (2012), *available at* http://www.blm.gov/public_land_statistics/pls11/pls2011.pdf [hereinafter "PUBLIC LAND STATISTICS"].

[133] *Id.* at 56-57 (Table 2-5).

[134] U.S. Dep't of Interior, Bureau of Land Mgmt., Wildlife Management (Sept. 7, 2010), http://www.blm.gov/wo/st/en/prog/more/fish__wildlife_and/wildlife3.html.

[135] FISCHMAN, *supra* note 83, at 21.

[136] 43 U.S.C. §§ 1701 – 1787 (2011).

[137] *Id.* § 1701(7).

[138] § 1701(8).

BLM implements its multiple-use, sustained yield mandate through comprehensive planning that involves continuing resource inventories,[139] land use plans,[140] and plan implementation through particularized decisions. Like the Forest Service, BLM uses a systematic interdisciplinary planning approach to integrate physical, biological, economic, and other sciences.[141] To the maximum extent consistent with federal law, BLM, again like the Forest Service, coordinates with the land use planning and management activities of other federal agencies, states, and local governments.[142] As part of the planning process, BLM must consider present and potential uses of the public lands, and weigh long-term benefits to the public against short-term benefits.[143]

Although FLPMA requires BLM to protect the ecological and environmental values of the wildlife habitat it oversees, nonwildlife activities constitute a substantial portion of BLM's multiple-use endeavors.[144] BLM has leased almost forty million acres for oil and gas development[145] and half of a million acres for coal mining,[146] and authorized more than 150 million acres

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[139] § 1711.

[140] § 1712.

[141] § 1712(c)(2).

[142] § 1712(c).

[143] *Id.*

[144] George Cameron Coggins observed nearly thirty years ago that "BLM publicly pronounces that it has a responsibility to manage for the welfare of all resident species, but this commitment tends to erode in the field." *See supra* note 116, at 45-46. The most recent statistics of BLM activity show that little has changed over the last three decades.

[145] PUBLIC LAND STATISTICS, *supra* note 132, at 107 (Table 3-13).

[146] PUBLIC LAND STATISTICS, *supra* note 132, at 126 (Table 3-18).

for livestock grazing.[147] During fiscal year 2011, nonwildlife activities on BLM lands generated $244 million in receipts, [148] $45 million of which BLM allocated to states and local governments.[149] Mineral leasing and timber sales have been two of BLM's largest sources of revenue, generating roughly $130 million[150] and $20 million,[151] respectively, in fiscal year 2011 revenues. BLM lands are a locus for recreation, including camping, off-road travel, hunting, and fishing,[152] tallying 70 million recreational visitor days in 2011.[153] All of these economic engines provide incentives for state and local government to influence BLM management decisions through FLPMA's command to BLM to coordinate with state and local resource planning.[154]

Overlay Lands

Lands designated wilderness areas, national monuments, and wild and scenic rivers overlay other federal agency lands but are subject to special congressionally determined management objectives.[155] Wilderness lands,

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[147] U.S. Dep't Interior, Bureau of Land Mgmt., Fact Sheet on the BLM's Management of Livestock Grazing (April 2012), http://www.blm.gov/wo/st/en/prog/grazing.print.html.

[148] PUBLIC LAND STATISTICS, *supra* note 132, at 155 (Table 3-26).

[149] PUBLIC LAND STATISTICS, *supra* note 132, at 158 (Table 3-28).

[150] PUBLIC LAND STATISTICS, *supra* note 132, at 153 (Table 3-26).

[151] PUBLIC LAND STATISTICS, *supra* note 132, at 97 (Table 3-11). However, this figure exaggerates the extent to which timber sales are normal BLM activity. Essentially all of the sales came from one state—Oregon, on lands that reverted to the United States when the successors to the Oregon and California Railroad Company failed to meet the terms of a land grant. *Id.* at 99 (Table 3-12); *Or. & Cal. R.R. Co. v. United States*, 238 U.S. 393 (1915); *see also* Robert H. Nelson, *The Federal Land Management Agencies*, *in* A NEW CENTURY FOR NATURAL RESOURCES MANAGEMENT, *supra* note 57, at 37, 38.

[152] PUBLIC LAND STATISTICS, *supra* note 132, at 196-97 (Table 4-2).

[153] PUBLIC LAND STATISTICS, *supra* note 132, at 193 (Table 4-1).

[154] 43 U.S.C. § 1712(c).

[155] *See generally* FISCHMAN, *supra* note 83, at 22-23.

which total nearly 110 million acres,[156] are subject to a preservationist mandate that generally prohibits roads, buildings, and motor vehicles.[157] Wilderness lands are scattered across all four major federal land management agencies, though nearly three-quarters of wilderness lands are within national forests and national parks. The more than 110 national monuments cover roughly three-quarters as many acres as wilderness areas[158] and are similarly scattered across the primary federal land managers[159] and subject to a preservation mandate.[160] Wild and scenic rivers, finally, are also managed for protection and overlay multiple management jurisdictions.[161]

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156 Wilderness.net, Wilderness Statistic Reports (June 29, 2012), http://www.wilderness.net/index.cfm?fuse=NWPS (select "Acreage by Agency").

157 16 U.S.C. § 1131(a) (2011). The Act defines wilderness in part 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." *Id.* at (c).

158 Mark Squillace, *The Monumental Legacy of the Antiquities Act of 1906*, 37 GA. L. REV. 473, 488 (2003).

159 U.S. Dep't. of the Interior, Nat'l Park Svc., Antiquities Act 1906-2006: Frequently Asked Questions at *6, http://www.cr.nps.gov/archeology/sites/antiquities/FAQs.doc (last visited Aug. 18, 2012).

160 16 U.S.C. § 431 (2011).

161 FISCHMAN, *supra* note 83, at 23.

IV. WILDLIFE IN A CHANGING CLIMATE

Variations in climatic conditions will bring about potentially dramatic changes for wildlife. Warming temperatures, varying precipitation, and increasing frequency and intensity of extreme weather events will reshape the ecosystems wild animals inhabit. These changes will produce a multitude of challenges to wildlife survival and raise serious questions about U.S. wildlife management methods and the legal infrastructure that supports them.

For many species, the most immediate effect of changing climate will be habitat variation and elimination. Warming temperatures and changing precipitation will lead to changes in the natural realms wild creatures have evolved to inhabit. Droughts, fires, tornadoes, floods, and hurricanes, which under changing climate conditions will increase in both frequency and intensity, will reshape the ecosystems wild creatures inhabit.[1]As those habitat changes take hold, wildlife will be forced to seek out new ranges. Migration in response to changing habitat conditions will cause new ecological relationships to evolve. New relationships, such as the introduction

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[1] INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: WORKING GROUP I: THE PHYSICAL SCIENCE BASIS, DIRECT OBSERVATIONS OF CLIMATE CHANGE, http://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmsspm-direct-observations.html (last visited Aug. 1, 2012) [hereinafter IPCC Direct Observations].

of an apex predator or disease, can send consequences cascading throughout the food web, rearranging an ecosystem in the process.[2]

The outlook for the United States wildlife resources is therefore dire, though riddled with uncertainty. When and how climate will change, let alone how wild animals will react to those changes, are beyond the pale of current understanding. Were U.S. wildlife management institutions designed to deal with uncertainty, the challenges of climate change would nonetheless be formidable. But, instead, U.S. wildlife management is predicated on predictive capacity—in other words, knowledge of future conditions—and a patchwork of isolated managers addressing different components of management problems.

Multiple-use resource managers like BLM will be hard pressed to comply with sustained yield mandates when changing climate conditions render uncertain the future predictions upon which present-day management decisions depend. Nor will dominant-use managers escape the challenge. In a changing climate, in which natural conditions rapidly evolve, preserving nature—as dominant-use management statutes typically require—will become increasingly challenging. The patchwork system of wildlife management jurisdiction and fragmentation of wildlife habitat will only undermine efforts to respond to these shortcomings.

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[2] PETER J. MORIN, COMMUNITY ECOLOGY 196 (1999).

Climate Change

Earth's climate is changing.[3] Average temperatures are increasing, precipitation calendars shifting, glaciers and ice caps melting, and sea levels rising. The rate at which these changes are occurring is on the rise. Of the twelve years from 1995 to 2006, eleven ranked among the twelve hottest years on record.[4] 2005 was the warmest year on record, and the eight warmest have occurred since 2001.[5] March of 2012 saw nearly 8,000 daily high-temperature records broken in the United States.[6] While Earth's surface is warming at an average rate of about 3°F per century,[7] in the Arctic temperatures have increased at almost twice this rate in the last 100 years.[8] Both low and high average daily temperatures are increasing across the globe, and minimum daily and winter temperatures are increasing most rapidly.[9] Not only is the warming trend likely to continue, the rate at which it

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[3] The extent to which climate change is a subject of debate in U.S. politics belies the scientific consensus not only on the change of climate, but also the anthropogenic causes of change. *Compare* Neela Banerjee, *Obama, Romney Duel over Climate Change in Online Debate*, L.A. TIMES, Sept. 4, 2012, http://www.latimes.com/news/politics/la-pn-obama-romney-climate-change-20120904,0,3282640.story, *with* Union of Concern Scientists, Scientific Consensus on Global Warming, http://www.ucsusa.org/ssi/climate-change/scientific-consensus-on.html (last visited Sept. 4, 2012).

[4] IPCC Direct Observations, *supra* note 1.

[5] U.S. Envtl. Protection Agency, Climate Change Science: Temperature Changes, http://epa.gov/climatechange/science/recenttc.html (Apr. 14, 2011) [hereinafter EPA Climate Change Science].

[6] *Not Just March, But Start of 2012 Shatter US Records for Heat, Worrying Meteorologists*, WASH. POST, Apr. 9, 2012, http://www.washingtonpost.com/politics/not-just-march-but-start-of-2012-shatter-us-records-for-heat-worrying-meteorologists/2012/04/09/gIQAdlbJ5S_story.html?tid=pm_pop. March temperatures in the continental United States were 8.6 degrees above average, and 6 degrees over average for the first three months of the year. *Id.*

[7] EPA Climate Change Science, *supra* note 5.

[8] EPA Climate Change Science, *supra* note 5.

[9] EPA Climate Change Science, *supra* note 5.

occurs is likely to quicken.[10] Over the last century, temperatures in the contiguous United States rose an average of 0.11°F per decade.[11] The warming trend for the last fifty years is twice that of the last century.[12] Since 1979, the rate of warming has increased more than five fold.[13]

As a result of warming temperatures, the natural world is changing. For example, glaciers and polar ice caps are melting, lakes and rivers frozen from winter chills thaw earlier in the year, and total average snow coverage is decreasing.[14] Since 1920, spring and summer snow coverage in the northern hemisphere has decreased, with an increase in the rate of decline beginning in the 1970s,[15] consistent with the increase in the rate of warming that also occurred in the same period. Maximum snow coverage now occurs one month earlier, average annual snow coverage is lower to a statistically significant degree, and spring melt-off occurs two weeks earlier than it did in 1972.[16]

In the Arctic, where average temperatures are increasing twice as fast as in the rest of the world,[17] sea ice is rapidly disappearing.[18] At the same

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[10] IPCC Direct Observations, *supra* note 1.

[11] EPA Climate Change Science, *supra* note 5.

[12] IPCC Direct Observations, *supra* note 1.

[13] EPA Climate Change Science, *supra* note 5.

[14] IPCC Direct Observations, *supra* note 1.

[15] Peter Lemke et al., *Observations: Changes in Snow, Ice, and Frozen Ground*, *in* IPCC FOURTH ASSESSMENT REPORT: CLIMATE CHANGE 2007, at 337, 343 (U.N. 2007).

[16] *Id.* at 343-44. Each of these changes has noteworthy effects on wildlife. *See* discussion *infra* at 58-63. Also see, for example, Rocky Barker, *Climate Change Accelerating, Complicating Idaho's Spring Runoff*, IDAHO STATESMAN, May 8, 2012, http://www.idahostatesman.com/2012/05/08/2107406/climate-change-accelerating-complicating.html.

[17] IPCC Direct Observations, *supra* note 1.

time, inland glacial ice is vanishing.[19] The glaciers of the Northwest United States and Southwest Canada are among those most rapidly disappearing.[20] Glacier National Park in Montana will lose its namesake by 2020.[21] The glaciers of the North Cascade Mountains in Washington have lost roughly thirty percent of their mass since 1984,[22] some have disappeared entirely,[23] and others are expected to melt into oblivion in the near future.[24]

The warming trend will result in increases in both the frequency and intensity of extreme climatic events. In the Eastern United States, statistically significant increases in the frequency of extreme precipitation events have already been observed.[25] While some locations in the United States will receive more water, in other places, droughts will be longer and

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[18] IPCC Direct Observations, *supra* note 1; *Beating a Retreat: Arctic Sea Ice Is Melting Far Faster than Climate Models Predict. Why?*, ECONOMIST, Sept. 24, 2011, http://www.economist.com/node/21530079 [hereinafter "*Beating a Retreat*"]. While the ice literally melts away beneath the wild inhabitants of the poles, new threats are emerging. For example, polar bears, seals, and walruses are suffering from a mortal disease, first observed in 2011, the cause of which remains unknown. Yereth Rosen, *Polar Bears Have Symptoms of Mystery Disease*, SCI. AM., Apr. 6, 2012, http://www.scientificamerican.com/article.cfm?id=polar-bears-havesymptoms-of-myster.

[19] IPCC Direct Observations, *supra* note 1.

[20] Lemke et al., *supra* note 15, at 357.

[21] Anne Minard, *No More Glaciers in Glacier National Park by 2020?*, NAT'L GEOGRAPHIC, March 2, 2009, http://news.nationalgeographic.com/news/2009/03/090302-glaciers-melting.html. *See* Robert B. Keiter, *The National Park System: Visions for Tomorrow*, 50 NAT. RESOURCES J. 70, 88 (2010) (noting that national parks provide an "ideal setting to study the effects of climate change").

[22] North Cascade Glacier Climate Project, http://www.nichols.edu/departments/glacier/intro.htm (March 11, 2011); M. S. Pelto, *Glacier Annual Balance Measurement, Forecasting and Climate Correlations, North Cascades, Washington 1984-2006*, 2 CRYOSPHERE 13, 15 (2008) (discussing a loss of 20-40% of glacial mass), *available at* http://www.the-cryosphere.net/2/13/2008/tc-2-13-2008.pdf.

[23] Pelto, *supra* note 22, at 15 (discussing the loss of the Spider and Lewis Glaciers).

[24] *Cascades Glacier May Vanish by End of Century*, SEATTLE TIMES, Sept. 13, 2004, http://seattletimes.nwsource.com/html/localnews/2002034050_glaciers13m.html.

[25] IPCC Direct Observations, *supra* note 1.

more intense.[26] Heat waves too will intensify, as will tropical cyclones.[27] Thus the many recent extreme weather events, such as floods and fires, may be harbingers of life in a changing climate.[28]

Although much is known about the climatic changes that have occurred, tremendous uncertainty underlies what changes in climate the future will bring. This is due in part to lack of human knowledge of future conditions, but also as a result of the phenomena associated with complex climate systems. For example, in complex systems, variables can interact to create feedback loops, such that the change of one variable interacting with other variables either reinforces or suppresses the original change.[29] Thus rising temperatures melt snow ice, which in turn reduces surface reflectance of heat from the sun, thereby increasing heat absorption and temperatures, which in turn leads to more melting of ice and snow.[30] The opposite occurs with cooling temperatures, which increase snow and ice packs, thereby increasing surface reflectance and decreasing heat absorption and temperature, leading to larger snow and ice packs.[31] Understanding of these

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[26] IPCC Direct Observations, *supra* note 1.

[27] IPCC Direct Observations, *supra* note 1.

[28] Laura Zuckerman, *North and South Dakota Prepare Flood Evacuations*, REUTERS, June 1, 2011, http://www.reuters.com/article/2011/06/01/us-usa-flooding-plains-idUSTRE7506GT20110601; Nathan Koppel & Daniel Gilbert, *Even After Rain, Texas Drought Persists,* WALL ST. J., Feb. 6, 2012, http://online.wsj.com/article/SB10001424052970204369404577205462072689468.html.

[29] Nat'l Snow & Ice Data Ctr., Feedback Loops: Interactions That Influence Arctic Climate, http://nsidc.org/arcticmet/patterns/feedback_loops.html (last visited Feb. 26, 2012); *Beating a Retreat*, *supra* note 18.

[30] Nat'l Snow & Ice Data Ctr., *supra* note 29.

[31] Nat'l Snow & Ice Data Ctr., *supra* note 29.

feedback relationships, which can lead to abrupt, nonlinear changes, is incomplete.[32]

Threats to Wildlife

For wildlife, climate change most directly means habitat change because temperature and precipitation variations will impact the foundation of wildlife habitat—vegetation. The flow of energy through the plant-based ecosystems U.S. wildlife inhabit—the trophic structure—is pyramid shaped: at the base of the pyramid, plants process the most energy, with successively less energy processed each step up the pyramid through herbivores and ultimately apex carnivores.[33] Each step of the pyramid depends for its ability to process energy on the step below it processing energy.[34] Changes in plant life accordingly ripple across natural systems: herbivores dependent on climate change-impacted plants seek out replacement food sources, and the carnivores dependent on herbivores follow in tow.

Such habitat change is but one of many pressures wildlife will face in a changing climate. While wild creatures endure the challenges of changing surroundings, they also will confront disease, as warming temperatures expand the range of insect disease vectors. And as wild animals cope with disease and homelessness, their biological clocks will start to shift with the

[32] *Beating a Retreat*, *supra* note 18.
[33] F. STUART CHAPIN, III, ET AL., PRINCIPLES OF TERRESTRIAL ECOSYSTEM ECOLOGY 307 (2011).
[34] *Id.*

changing schedule of the seasons. In the face of these stark realities, some species will likely fail to endure.

Shifting Habitat

The first and foremost effect of climate change on wildlife will be the upslope and up-latitude movement of the conditions animals have evolved to inhabit.[35] Some creatures may be able to adapt in place to the new conditions.[36] Others must seek out new surroundings.[37] For wildlife, a predominant consequence of climate change will therefore be migration.[38] Such migration in search of suitable habitat is already occurring in Yosemite National Park, where small mammals are steadily moving upslope in search of habitat, as warming temperatures push upwards in elevation the conditions to which animals have tailored their survival.[39]

While many animals will have some room to move uphill, those already inhabiting the mountaintops have nowhere to run. For these creatures, a warming future is a nonexistent one. The American pika, a small, hamster-like creature that inhabits rocky slopes of mountain peaks in the Western

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[35] Jonathan Adams, *Parks and Protected Areas: Conserving Lands Across Administrative Borders*, *in* CONSERVATION FOR A NEW GENERATION: REDEFINING NATURAL RESOURCES MANAGEMENT 61, 72 (Richard L. Knight & Courtney White eds. 2008) (noting that "species will shift ranges poleward in latitude and up in altitude").

[36] *See* Chris D. Thomas et al., *Extinction Risk from Climate Change*, 427 NATURE 145, 145 (2004) (implying that some species will survive climate change).

[37] *Id.*

[38] *Id.*

[39] ANTHONY D. BARNOSKY, HEATSTROKE: NATURE IN AN AGE OF GLOBAL WARMING 82 (2009); Craig Moritz et al., *Impact of a Century of Climate Change on Small-Mammal Communities in Yosemite National Park, USA*, 10 SCIENCE 261 (2008).

United States, provides but one example of species to be stranded by climate change. Variations in temperatures, precipitation, and the timing of snowmelt—symptoms of climate change—have already significantly impacted pika survival.[40] Because pikas inhabit mountaintops, they cannot move uphill in search of new habitat.[41] They are, quite literally, stranded on an island mountaintop,[42] as the conditions pikas need for survival disappear before their eyes. As a result, along with their habitat, pikas are rapidly disappearing from the mountains of the Great Basin.[43] Of the populations recorded in the 19th century, nearly half have gone extinct sine 1999.[44]

The same pattern of upward migration, isolation, and extinction has been observed in California's populations of desert bighorn sheep.[45] The desert bighorn lives in widely dispersed groups in the mountains of the arid southwestern United States, including southeastern California.[46] During the twentieth century, mean annual temperature increased by approximately 1.5°F and average annual precipitation fell roughly twenty percent in the

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[40] Shawn F. Morrison & David S. Hik, *Demographic Analysis of a Declining Pika* Ochotona Collaris *Population: Linking Surivial to Broad-Scale Climate Patterns via Spring Snowmelt Patterns*, 76 J. ANIMAL ECOLOGY 899 (2007).

[41] ROBERT L. PETERS, BEYOND CUTTING EMISSIONS: PROTECTING WILDLIFE AND ECOSYSTEMS IN A WARMING WORLD 10 (Defenders of Wildlife 2008).

[42] For a sample discussion of islands and climate change, see Anthony D. Barnosky, *"Big Game" Extinction Caused by Late Pleistocene Climatic Change: Irish Elk (*Megaloceros giganteus*) in Ireland*, 25 QUARTERNARY RESEARCH 128 (1986).

[43] BARNOSKY, *supra* note 39, at 43; *see also* Erik A. Beever et al., *Contemporary Climate Change Alters the Pace and Drivers of Extinction*, 17 GLOBAL CHANGE BIO. 2054 (2011).

[44] BARNOSKY, *supra* note 39, at 43; Beever et al., *supra* note X.

[45] BARNOSKY, *supra* note 39, at 44; Clinton W. Epps et al., *Effects of Climate Change on Population Persistence of Desert-Dwelling Mountain Sheep in California*, 18 CONSERVATION BIO. 102 (2004).

[46] Calif. Dept. Fish & Game, Desert Bighorn Sheep Facts, http://www.dfg.ca.gov/wildlife/Bighorn/Desert/ (last visited Sept. 9, 2012).

Southern California desert mountains.[47] As a result of warming temperatures and decreasing precipitation in the region, habitat previously suitable for desert bighorn survival disappeared.[48] Because lower elevations grew hotter and drier, habitat became more widely dispersed among higher elevation islands, resulting in increased bighorn population isolation.[49] As in the case of the pika, segregated populations ran out of places to run, and disappeared when favorable habitat conditions no longer persisted.[50] Of the eighty populations of desert bighorn sheep known to have inhabited California's mountains during the last one hundred years, thirty have gone extinct.[51]

Warming temperatures will also eradicate fish habitat. For example, trout, which depend for survival on the availability of cold waters to inhabit, will suffer widespread habitat loss as a result of warming temperatures. The Eastern Brook Trout, which swims many of the creeks, rivers, lakes, and reservoirs of the Appalachian Mountains, cannot survive water temperatures exceeding 68°F. [52] A 5°F increase in average annual temperature, which may

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[47] Clinton W. Epps et al., *Effects of Climate Change on Population Persistence of Desert-Dwelling Mountain Sheep in California*, 18 CONSERVATION BIO. 102, 103 (2004), *available at* http://fw.oregonstate.edu/labs/epps/pdfs/Epps%20et%20al%20Consbio2004.pdf.

[48] *See generally id.*

[49] *Id.* at 103.

[50] *Id.*

[51] BARNOSKY, *supra* note 39, at 44.

[52] EASTERN BROOK TROUT JOINT VENTURE, CONSERVING THE EASTERN BROOK TROUT: ACTION STRATEGIES 46 (2008); *see also* Ashley D. Ficke, Christopher A. Myrick, & Lara J. Hansen, *Potential Impacts of Global Climate Change on Freshwater Fisheries*, 17 REV. FISH BIO. & FISHERIES 581, 593 (2007) (discussing fish temperature tolerances), *available at* http://changingclimate.osu.edu/assets/pubs/ficke-2007.pdf.

occur within the next century,[53] will warm waters to the point of losing more than ninety percent of the trout habitat in North Carolina and Virginia.[54] Similar futures are forecast for coldwater fish habitat across the United States.[55]

In the prairie pothole region of the Upper Midwest—the breeding grounds for millions of ducks and geese—decreasing precipitation and increasing temperatures are expected to decrease waterfowl reproduction by as much as seventy percent through the elimination of breeding habitat.[56] The Arctic, which serves as the other major breeding ground for North American waterfowl, is expected to see a fifty percent reduction in reproduction within the next hundred years.[57]

Disease

While the wildlife of the United States searches for new habitat and works to adapt to a changing world, new threats will emerge in the form of

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[53] IPCC Fourth Assessment Report: Climate Change 2007, Projections of Future Changes in Climate, http://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmsspm-projections-of.html (last visited Sept. 8, 2012).

[54] EASTERN BROOK TROUT JOINT VENTURE, *supra* note X, at 5.

[55] Sarah E. Null et al., *Stream Temperature Sensitivity to Climate Warming in California's Sierra Nevada: Impacts to Coldwater Habitat*, 113 CLIMATE CHANGE *ONLINE FIRST* (Apr. 23, 2012), *available at* http://www.springerlink.com/content/n74364n482601126/; Jason C. Leppi et al., *Impacts of Climate Change on August Stream Discharge in the Central-Rocky Mountains*, 112 CLIMATE CHANGE 997 (2012); Nathan Mantua, Ingrid Tohver, and Alan Hamlet, *Climate Change Impacts on Streamflow Extremes and Summertime Stream Temperature and Their Possible Consequences for Freshwater Salmon Habitat in Washington State*, 102 CLIMATE CHANGE 187 (2010).

[56] GLOBAL CLIMATE CHANGE AND WILDLIFE IN NORTH AMERICA: TECHNICAL REVIEW 04-2-2004, at 12 (Wildlife Society, Krista E. M. Galley ed., 2004).

[57] INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY: WORKING GROUP II CONTRIBUTION TO THE FOURTH ASSESSMENT REPORT, 239.

disease. Most vector-born diseases are spread through insects, such as mosquitoes, flies, fleas, and ticks.[58] Because insects are cold-blooded, temperature is the primary factor limiting the range that disease vector insects inhabit.[59] As temperature increases, vector insect range expands. Accordingly, increases in temperature lead to expansions of disease distribution.[60]

Avian malaria provides one example of this dynamic.[61] Carried by mosquitoes, avian malaria is destroying native bird populations in Hawaii.[62] Because colder temperatures are less conducive to mosquito survival and reproduction, birds inhabiting higher, colder elevations have been less susceptible to avian malaria infection from mosquitoes.[63] But as temperatures warm, mosquito range expands upward, exposing previously insulated bird populations to the deadly malaria virus. Ticks, which like mosquitoes act as major disease vectors,[64] have similarly expanded their

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[58] Jonathan A. Patz et al., *Disease Emergence from Global Climate and Land Use Change*, 92 MED. CLINICS N. AM. 1473, 1473 (2008).

[59] Christina Schmidt, *Insects Emerge in Nice Weather*, CASPER J., Apr. 8, 2012 (noting early normal insect emergence), http://www.casperjournal.com/news/article_085edda6-4b35-5101-84c2-c9b56796d820.html.

[60] Patz et al., *supra* note 58, at 1473-74; C. Drew Harvell, et al., *Climate Warming and Disease Risk for Terrestrial and Marine Biota*, 296 SCIENCE 2158, 2160 (2002) ("vector-borne diseases are the strongest candidates for altered abundance and geographic range shifts because rising temperatures will affect vector distribution, parasite development, and transmission rates.").

[6161] Harvell et al., *supra* note 60, at 2160; Erik Hofmeister, et al., Climate Change and Wildlife Health: Direct and Indirect Effects 2 (U.S. Geo. Survey Nat'l Wildlife Health Ctr. 2010), *available at* http://pubs.usgs.gov/fs/2010/3017/.

[62] Harvell et al., *supra* note 60, at 2160; *see also* Laszlo Z. Garamszegi, *Climate Change Increases the Risk of Malaria in Birds*, 17 GLOBAL CHANGE BIOLOGY 1751 (2011).

[63] Harvell et al., *supra* note 60, at 2160.

[64] University of Calif, Davis, Center for Vectorborne Diseases, Tickborne Disease Research Program, http://cvec.ucdavis.edu/tickborne (last visited Aug. 11, 2012).

range uphill.[65]

In other cases, diseases will expand northward in latitude rather than upward in elevation. For instance, for the last fifteen years the lung parasite, which infects caribou, has expanded north from the Pacific Coastal Range of the United States all the way to Alaska and the Yukon and Northwest Territories of Canada.[66] In similar fashion, the brain worm, which causes a fatal neurological disease in moose, will expand its range northward with warmer temperatures and milder winters.[67]

Changing Biology

As species try to cope with shifting habitat and disease, their biological clocks will fall off schedule. The effects of warming temperatures, such as earlier spring snowmelt, will throw the timing of animals' major life events, such as reproduction and migration, out of sync.[68] These life events are intricately linked to the timing of the seasons: animals typically give birth in the spring, migrate to warmer locations in the fall, and migrate back to cooler

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[65] Patrick A. Leighton et al., *Predicting the Speed of Tick Invasion: An Empirical Model of Range Expansion for the Lyme Disease Evtor* Ixodes Scapularis *in Canada*, 49 J. APPLIED ECOLOGY 457 (2012), *available at* http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2012.02112.x/abstract. The study concluded that temperature was the most significant factor driving tick habitat expansion. *Id.* at 457.

[66] Hofmeister, et al., *supra* note X, at 1. Warming temperatures in the North have led to increased disease outbreaks in humans as well. *See, e.g.*, Sherilee L. Harper et al., *Weather, Water Quality and Infectious Gastrointestinal Illness in Two Inuit Communities in Nunatsiavut, Canada: Potential Implications for Climate Change*, 8 ECOHEALTH 93 (2011).

[67] Hofmeister et al, *supra* note X, at 3; *see also* Robert S. Rempel, *Effects of Climate Change on Moose Populations: Exploring the Response Horizon Through Biometric and Systems Models*, 222 ECOL. MODELING 3,355 (2011).

[68] *See, e.g.*, Peter A. Cotton, *Avian Migration Phenology and Global Climate Change*, 100 PROCS. NAT'L ACAD. SCI. 12,219 (2003), *available at* http://www.pnas.org/content/100/21/12219.full.pdf+html.

elevations in the spring.[69] As a result of warming temperatures, the timing of the conditions that trigger these life events, such as melting snow prompting migration to summer range, will change.[70]

Like most wild creatures, broad-tailed hummingbirds time major life events to coordinate with natural conditions. The birds travel from Central America to breed in subalpine regions of the Western United States, timing their arrival to correspond with the blooming of particular flowers that provide the birds with nutritious nectar.[71] Like the hummingbird, the flowers, in turn, coordinate a major life event—blooming—with a natural condition—snow melt.[72] As the snow melts earlier as a result of warming temperatures, the flowers bloom earlier.[73] Consequently, the hummingbirds must arrive earlier, or lose out on an important food source.[74] Based upon current trends in the timing of flowering and bird arrival, the hummingbirds will miss the blooms entirely in twenty years.[75] The hummingbirds must therefore adapt to the changing climate by migrating earlier or finding a substitute food source, or face extinction.

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[69] HUGH DINGLE, MIGRATION: THE BIOLOGY OF LIFE ON THE MOVE 234 (1996).

[70] Schmidt, *supra* note 59.

[71] Amy Marie McKinney et al., *Asynchronous Changes in Phenology of Migrating Broad-Tailed Hummingbirds and Their Early-Season Nectar Resources*, 93 ECOL. (June 2012), http://www.esajournals.org/doi/abs/10.1890/12-0255.1.

[72] *Id.*

[73] *Id.*

[74] *Id.*

[75] *Id.*

Ripple Effects

Any given species might not survive the stresses of climate change. The broad-tailed hummingbird might not be able to find a substitute food source if it arrives too late to the flower buffet. The pika and desert bighorn could be left with nowhere to run as their habitats are cooked out of existence. In each case, consequences of the loss of a species will impact ecological relationships. The greater the role the species plays in its ecosystem, the bigger the consequences of loss.

The story of the whitebark pine shows how climate change induced species loss can cascade effects across a natural system. A high-elevation conifer particularly abundant in the greater Yellowstone ecosystem of the Northern Rocky Mountains, the whitebark pine provides a critical food source for the Clark's nutcracker, grizzly and black bears, and red squirrels, all of which feed on the tree's highly nutritious seeds.[76] A mutually dependent relationship has evolved between the whitebark pine and the nutcracker: the nutcracker feeds almost exclusively on the seeds of the whitebark, which in turn depends entirely on the nutcracker to disperse its seeds for growth of whitebark seedlings.[77]

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[76] Jesse A. Logan & James A. Powell, *Ghost Forests, Global Warming, and the Mountain Pine Beetle (*Coleoptera: Scolytideae*)*, 47 AM. ENTEMOLOGIST 160, 161 (2001); Robert E. Keane, Penelope Morgan, & James P. Menakis, *Landscape Assessment of the Decline of Whitebark Pine (*Pinus albicaulis*) in the Bob Marshall Wilderness Complex, Montana, USA*, 68 N.W. SCI. 213, 213 (1994).

[77] Logan & Powell, *supra* note 76; Keane, Morgan, & Menakis, *supra* note 76.

Like the nutcracker, red squirrels eat the pine seeds, secreting away large stores for winter-feeding.[78] Bears, in turn, raid those stashes, helping them to develop fat stores necessary for hibernation.[79] The nutrition the whitebark pine seeds provide to bears are particularly important for females, which need sufficient fat reserves for gestation during hibernation.[80] As a result of these relationships, the whitebark is considered a "keystone" species,[81] holding together many parts in a complex ecosystem.

Increasing average temperatures and other climatic changes have rendered the whitebark pine particularly susceptible to disease and death. The mountain pine beetle, for example, has recently ravaged whitebark pine populations.[82] The parasitic larvae of the pine beetle feed on the inner bark of host pine trees, sickening and eventually killing the host.[83] In some outbreak locations, the beetles have killed more than 95% of coniferous trees.[84] While the beetle has long played a role in the ecology of low elevation pine forests dominated by ponderosa and lodgepole pines, it previously had little effect on high-elevation conifers, such as the whitebark pine, because cold high-

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[78] Logan & Powell, *supra* note 76.

[79] Logan & Powell, *supra* note 76.

[80] Logan & Powell, *supra* note 76.

[81] DAVID SADAVA ET AL., LIFE: THE SCIENCE OF BIOLOGY 1209 (9th ed. 2011) (defining keystone species as one "that exerts an influence on a community disproportionate to its abundance); *accord* PETER H. RAVEN ET AL., ENVIRONMENT 103 (8th ed. 2012).

[82] Logan & Powell, *supra* note 76; Keane, Morgan, & Menakis, *supra* note 76.

[83] Logan & Powell, *supra* note 76.

[84] Jesse A. Logan, William M. Macfarlane, & Louisa Wilcox, *Whitebark Pine Vulnerability to Climate-Driven Mountain Pine Beetle Disturbance in the Greater Yellowstone Ecosystem*, 20 ECOLOGICAL APPS. 895, 895 (2010), *available at* http://www.esajournals.org/doi/pdf/10.1890/09-0655.1

elevation temperatures prevented the beetle from completing its life cycle.[85] However, increasing average temperatures have moved the temperature barrier to higher elevations.[86] As a result, pine beetles have infested whitebark pines on a scale never before observed.[87] Trees weakened by beetles are in turn more susceptible to blister rust, an invasive fungus also deadly to the whitebark bine.[88] Trees infected by blister rust are likewise more susceptible to beetle infestation.[89] In this way, the beetle and blister rust—conditions resulting from human activities—synergistically interact to the detriment of the whitebark pine, as well as the species depending on its survival.

Changing climate has thus exposed the whitebark pine to a previously foreign beetle and increased the pine's exposure to a human introduced pathogen. Now a critical food source for multiple species, the whitebark pine, stands in peril.[90] As the whitebark pine succumbs to the changing climate, the consequences of its keystone status will cascade across the ecosystem.[91] Red squirrels will lose their primary food source. When the bears look for the squirrels' seed stashes, in the hopes of building fat needed for hibernation, they will search in vein. And when the expectant female bears go into

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[85] Logan & Powell, *supra* note 76.

[86] Logan & Powell, *supra* note 76.

[87] Logan & Powell, *supra* note 76, at 162.

[88] Logan, Macfarlane, & Wilcox, *supra* note 84, at 900; Keane, Morgan, & Menakis, *supra* note 76.

[89] *Id.*

[90] Logan, Macfarlane, & Wilcox, *supra* note 84, at 900.

[91] BARNOSKY, *supra* note 39, at 157-58 (noting that the whitebark may disappear entirely from Yellowstone, resulting in "enormous consequences").

hibernation without adequate fat stores, hopes for successful reproduction will diminish.

These consequences will ripple throughout the whitebark pine ecosystem as the pine population decreases.[92] The whitebark might not simply continue to dwindle in numbers, it might disappear from the Greater Yellowstone Ecosystem.[93] The consequences of the disappearance of a keystone species, such as the whitebark, with its disproportionately large impact on the ecosystem it occupies, would spread across the entire trophic structure of the ecosystem. For the bears, the nutcracker, and the squirrels, the disappearance of the whitebark pine is a climate-induced habitat change. To survive, each species that previously depended on the whitebark pine for its sustenance must find another food source. For some that will mean adaptation in place; for others, seeking out new territory. In some cases, the search for new habitat will lead animals into conflict with humans. Bears unable to find nourishment in whitebark pine seeds, for example, will venture to lower elevations in search of food, where they will likely find an unwelcoming human world.[94]

The story of the whitebark pine forests is not unique. The drought-stressed hemlock forests of the Eastern United States are similarly suffering,

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[92] Logan & Powell, *supra* note 76.

[93] John R. Platt, *Whitebark Pine Turned Down for Endangered Species List*, SCI. AM., July 21, 2011, http://blogs.scientificamerican.com/extinction-countdown/2011/07/21/whitebark-pine-turned-down-for-endangered-species-list/. In the last decade, 50% of the whitebark pines in Yellowstone have died. *Id.*

[94] FRED VAN DYKE, CONSERVATION BIOLOGY 134 (2d ed. 2008) (noting increased grizzly-human conflict during whitebark pine seed shortages).

with analogous consequences likely to follow.[95] In both cases, massive stands of dead and dying trees will provide fuel for colossal fires.[96] In the charred remains, some species will endure, while others seek out new homes, and still others disappear.[97]

Management Challenges

The dramatic effects climate change will have on wildlife will create monumental challenges for wildlife managers. Scientific uncertainty, already a barrier to effective management, will expand exponentially and cripple front-loaded wildlife management processes. As wild animals respond to climate change, for example by searching out new habitat, they will encounter a deeply fragmented patchwork of habitat subject to varying legal mandates and controlled by institutions unprepared to respond to the challenges that lie ahead.

Scientific Uncertainty

Uncertainty is the hallmark of wildlife management in a changing climate.[98] Although general conclusions can be drawn—that warming will continue, precipitation patterns will change, and extreme events will become

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[95] PETERS, *supra* note 41, at 8.
[96] PETERS, *supra* note 41, at 8.
[97] PETERS, *supra* note 41, at 8.
[98] Alejandrao E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1 (2009) (describing uncertainty as "the paramount impediment raised by climate change").

more frequent—the nature, pace, and extent of future climate induced change at any given location remains uncertain.[99] Because specific knowledge of change remains elusive, land and wildlife resource managers face a tremendous challenge.[100] Will habitat change? If so, when and how will wildlife respond? Will a given species leave a jurisdiction altogether in search of new habitat? When and how will life cycles shift, and how will wild creatures respond to new relationships with disease, competition, and predation?

These uncertainties are simply part of a "grab bag" of similar problems that all follow "from the fact that our finite knowledge will always fall short of any ideal of 'full' knowledge upon which to base everyday decisions."[101] The inability of wildlife management institutions to respond to the uncertainty amounts to a lack of "predictive capacity," a deficit that directly undermines prediction-dependent, traditional front-end wildlife management methods.[102]

Management of wildlife and other natural resources is fundamentally about developing plans based on factual conditions today to achieve

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[99] A FEDERAL PUBLIC LANDS AGENDA FOR THE 21ST CENTURY 13 (2008); Robert L. Glicksman, *Ecosystem Resilience to Disruptions Linked to Global Climate Change: An Adaptive Approach to Federal Land Management*, 87 NEB. L. REV. 833, 869 (2009). Professor Ruhl direly describes the conditions to come as "the no-analog future—ecological variability unprecedented in the history of ecology, riddled with nonlinear feedback and feedforward loops, previously unknown emergent properties, and new thresholds of irreversible change." J.B. Ruhl, *Climate Change Adaptation and the Structural Transformation of Environmental Law*, 40 ENVTL. L. 363, 394 (2010).

[100] Bryan G. NORTON, SUSTAINABILITY: A PHILOSOPHY OF ADAPTIVE ECOSYSTEM MANAGEMENT 101 (2005) (questioning "How can managers legitimately claim to manage in face of uncertainties?").

[101] *Id.* at 101.

[102] *Id.*; *see also* Ruhl, *supra* note 99, at 417 (describing lack of predictive capacity as the "Achilles heel" of environmental impact and cost-benefit analyses in a changing climate).

substantive aims in the future—such as sustainable yields or preservation—through formal processes, and then implementing those plans. Yet planning for the future (e.g., preservation or sustained yield) requires assumptions about future natural conditions. Under the discarded equilibrium view of ecosystems, assuming future conditions was simply a matter of controlling human impacts enough to preserve the natural status quo. However, ecosystems are not static, and predicting future conditions in complex natural systems requires considerable institutional capacity. Climate change will only increase the need for institutional ability to respond to uncertainty.

Unfortunately, resource agencies have done little to move beyond the routines of managing a static system. Traditional management processes focus more on what *is* than what *will be*.[103] In this way, in traditional resource management "[s]tatic and confused description replaces anticipation and clear prescription of alternatives."[104]

In a changing climate, what is today will likely not be in the future. The problem for wildlife management in a changing climate is a scientific shortage—we simply do not fully understand the "multitude of diverse, dispersed sources responding to coevolving interactions, feedback loops, and

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[103] ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT 6 (C.S. Holling ed. 1978) (hereinafter Holling).

[104] *Id.* at 6; *see also* Camacho, *supra* note 98, at 36-37 (noting that resource management agencies "are not designed to manage uncertainty or reduce the likelihood and magnitude of mistakes that often result from facing uncertain problems with imprecise tools.").

nonlinear cause-and-effect properties."[105] The potential for unforeseen climate change-induced conditions to render relied upon planning assumptions invalid is significant. As planning premises prove false, management objectives will be likely to fail.

Our inability to predict conditions upon which management decisions rely calls into question the current front-end approaches to planning.[106] How can a wildlife manager pursue sustained hunting yields of a species when it is difficult, and perhaps at times impossible, to know what threats the species will face or how the species will respond? We cannot expect the climate of the future to be like the climate of the past.[107] Wildlife management therefore cannot be in the future as it was in the past.

Fragmentation

Climate-driven changes in wild life will shine a bright light on jurisdictional, ecological, and political fragmentation in land and wildlife management.[108] Institutional division of responsibility for wildlife and habitat management will impede effective, coordinated responses to the

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[105] J.B. Ruhl, *Regulation by Adaptive Management—Is It Possible?*, 7 MINN. J.L. SCI. & TECH. 21, 22-23 (2006).

[106] Camacho, *supra* note 98, at 38.

[107] John D. Leshy, *Federal Lands in the Twenty-First Century*, 50 NAT. RESOURCES J. 111, 113-14 (2010).

[108] Camacho, *supra* note 98, at 26-27 (describing fragmentation across law, within agencies, and across natural systems); Evelyn Pinkerton, *Integrating Holism and Segmentalism: Overcoming Barriers to Adaptive Co-Management Between Management Agencies and Multi-Sector Bodies*, *in* ADAPTIVE CO-MANAGEMENT: COLLABORATION, LEARNING, AND MULTI-LEVEL GOVERNANCE 151, 159-62 (Derek Armitage, Fikret Berkes, & Nancy Doubleday eds. 2007) (describing fragmentation of interests and values, responsibility and authority, and information and knowledge).

many transboundary problems wildlife will face in a changing climate. The island approach to conservation will also destabilize wildlife management, as wild animals leave protected, dominant-use lands in search of new living arrangements. So too will divisions in political values, which ultimately control the management of wildlife and habitat, inhibit attempts to shepherd wildlife through the coming crises.

Responsibility to manage wildlife and habitat is not divided based upon ecology, but rather jurisdictional boundaries.[109] Consequently, different entities typically oversee segments of an ecosystem. Division of responsibility can be simply a matter of landownership, or based on an historical legal principle, such as state-centered management of wild animals. As a result of this division, different federal, state, and local government entities that play a role in managing wildlife and habitat can independently pursue different objectives. For example, the Park Service will manage land for preservation,[110] while BLM might manage neighboring land for resource extraction, such as mining.[111]Each management agency thus acts in relative isolation pursuing its own legal mandates and processes,[112] without any structure for coordination on common interests. In this fragmented and

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[109] *See* Glicksman, *supra* note 99, at 865 (arguing that "ecosystem boundaries should be determined by reference to ecology, not politics"); Reed F. Noss, *Some Principles of Conservation Biology, as They Apply to Environmental Law*, 69 CHI.-KENT L. REV. 893, 893 (1994).

[110] 16 U.S.C. § 1.

[111] *See, e.g.*, Connie Toops, *Running out of Range*, 74 NAT'L PARKS (July/Aug. 2000), at 30, 30-33 (describing pronghorn migrations from summer range in Grand Teton National Park to winter range on BLM lands dominated by oil and gas development).

[112] NORTON, *supra* note 100, at 23.

multilayered setting, wildlife managers are unlikely to respond effectively to the shared challenges climate change will pose.[113]

The patchwork management approach has endured only because of relative ecological stability, in which dominant-use reserves like national parks have acted as wildlife sanctuaries. However, as habitat changes, wild creatures will migrate in search of new grounds.[114] Thus, the island approach to conservation—where protecting a parcel of land protects the wildlife within it—will no longer work.[115] Not only will climate change undermine the historical piecework approach to conservation, the island approach will in turn make it more difficult for wildlife to respond to changing climate, as they leave protected habitat to navigate the land use patchwork. In this way, the ecological fragmentation of land ownership will be a central issue for wildlife managers in a changing climate.

Climate change will also intensify political divisions in wildlife management. How we appropriate resources for the purpose of supporting

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[113] *See* William W. Buzbee, *Recognizing the Regulatory Commons: A Theory of Regulatory Gaps*, 89 IOWA L. REV. 1 (2003). Professor Buzbee explains that "The more potential regulators are fragmented and mismatched with the underlying resource, or resource harm causes or effects, the less likely it is that regulatory action will occur. In such settings, a regulatory commons dynamic will exist." *Id.*

[114] *See* discussion *supra* at 59-63 and accompanying footnotes.

[115] Jonathan Adams, *Parks and Protected Areas: Conserving Lands Across Administrative Borders*, *in* CONSERVATION FOR A NEW GENERATION: REDEFINING NATURAL RESOURCES MANAGEMENT 61, 66-67 (Richard L. Knight & Courtney White eds. 2008); Daniel Schramm & Akiva Fishman, *Legal Frameworks for Adaptive Natural Resource Management in a Changing Climate*, 22 GEO. INT'L ENVTL. L. REV. 491, 514 (2010) (internal citation omitted).

wildlife is already a contentious issue.[116] Climate change will add new dimensions to this conflict. For example, human uses of natural resources will change in response to climate change.[117] Those changing resource uses will not always be compatible with wildlife needs, and some uses will even be harmful to wildlife. The effort to generate cleaner energy to mitigate climate-changing emissions, for example, has led to substantial development in wildlife habitat.[118] Deciding what place wildlife can occupy within the realm of human uses of the natural world in a changing climate will reflect society's value for wildlife as one among many resources.

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[116] *See, e.g.*, Brett Prettyman, *Controversy Aired Over State Wildlife Contract*, SALT LAKE TRIB., Aug. 16, 2012, http://www.sltrib.com/sltrib/news/54712497-78/wildlife-state-conservation-hunting.html.csp

[117] For example, changes in precipitation patterns, such as drought, will lead people to seek out new water sources. *See, e.g.*, Nigel W. Arnell, *Climate Change and Global Water Resources: SRES Emissions and Socio-Economic Scenarios*, 14 GLOBAL ENVTL. CHANGE 31 (2004).

[118] Examples of climate change mitigation energy strategies impacting wildlife habitat include natural gas and solar energy development, among others. *See, e.g.*, Emilene Ostlind, *BLM Stays Course in Wyoming Gas Patch Despite Mule Deer Decline*, HIGH COUNTRY NEWS, March 21, 2011, http://www.hcn.org/issues/43.5/blm-stays-course-in-wyoming-gaspatch-despite-mule-deer-decline; Johanna Wald, *Balance of Power: Clean Energy and Desert Wildlife*, FORBES, May 3, 2012, http://www.forbes.com/sites/toddwoody/2012/05/03/balance-of-power-clean-energy-and-desert-wildlife/; *see also* REBECCA BROOKE ET AL., CORN ETHANOL AND WILDLIFE: HOW INCREASES IN CORN PLANTINGS ARE AFFECTING HABITAT AND WILDLIFE IN THE PRAIRIE POTHOLE REGION (Nat'l Wildlife Fed. 2009).

V. ADAPTATION AND COLLABORATION

Adaptive management and collaborative governance are resource management techniques designed to resolve scientific uncertainty and piece together fragmented decision-making structures. Adaptive management departs from traditional front-end resource management methods, and focuses on resolving scientific uncertainty through experimental management. Collaborative governance institutionalizes shared decision-making processes to resolve collective problems with more durable and effective decisions. Accordingly, collaboration and adaptation, when practiced together, present seemingly ideal solutions to the challenges of uncertainty and fragmentation climate change will bring to managing human relations with wildlife.

Each of the federal land management agencies has recognized in policy the importance of collaborative and adaptive resource management in a changing climate. The Forest Service's climate change response strategy, for example, declares that adaptation to changing climate and collaboration among stakeholders will be "essential" to fulfilling the agency's sustained-yield management mandate.[1] The Bureau of Land Management, National Park Service, and Fish and Wildlife Service all similarly pronounce the importance of adaptation and collaboration.[2] Notwithstanding these policy efforts, as well as the theoretical appeal of both management methods, in practice, adaptive and collaborative efforts have mostly failed to meet expectations.

Adaptive Management

Human knowledge of the complex, dynamic ecological systems wild creatures inhabit is inevitably limited.[3] Climate change will exacerbate this knowledge deficiency, accelerating the scope, speed, and severity of ecological change.[4] Traditionally, the two mutually exclusive responses to shortages in ecological knowledge have been (a) to withhold action until uncertainty is resolved, or (b) to proceed, uncertainty notwithstanding.[5] This dichotomy creates in resource management decisions a zero-sum, no-action versus

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[1] U.S. Forest Service, Forest Service Strategic Framework for Responding to Climate Change 6 (2008), *available at* http://www.fs.fed.us/climatechange/documents/strategic-framework-climate-change-1-0.pdf. Enhancing adaptive capacity and establishing alliances are therefore central goals in the Service's response strategy. *Id.* at 7.

[2] *See* U.S. Dep't. of Interior Secretarial Order no. 3289 at §§ 2, 3(c) (Sept. 14, 2009); U.S. FISH & WILDLIFE SERVICE, RISING TO THE URGENT CHALLENGE: STRATEGIC PLAN FOR RESPONDING TO ACCELERATING CLIMATE CHANGE 13-14 (2010); U.S. NATIONAL PARK SERVICE, CLIMATE CHANGE RESPONSE STRATEGY 14, 21 (2010).

[3] ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT 7 (C.S. Holling ed. 1978) [hereinafter Holling]; *see also* Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1, 12 (2009); PANEL ON ADAPTIVE MANAGEMENT FOR RESOURCE STEWARDSHIP, ADAPTIVE MANAGEMENT FOR WATER RESOURCE PROJECT PLANNING 15 (Nat'l Academies Press 2004) [hereinafter AM FOR RESOURCE STEWARDSHIP].

[4] Camacho, *supra* note 3, at 13.

[5] HOLLING, *supra* note 3, at 7; *see also* Dan A. Farber, *Uncertainty*, 99 GEO. L.J. 901, 903 (2012).

unknown impact dilemma. A different, more pragmatic response to inadequate understanding of ecological systems is adaptive management.

Recognized in the legal scholarship as "the tonic of natural resource policy,"[6] "tailor-made for dealing with uncertainty,"[7] and "a commonsense strategy for addressing the reality of a changing and uncertain environment,"[8] adaptive management amounts to "learning by experience."[9] It is a management technique "designed to support action in the face of the limitations of scientific knowledge and the complexities and stochastic behavior of large ecosystems."[10] Adaptive managers use management decisions as experiments to learn about areas of uncertainty,[11] such as the relationships among ecological variables or the effectiveness of a particular management approach. By reducing uncertainty underlying management decisions, adaptive management creates more effective management actions, which can in the long run create a more reliable regulatory environment.

As its emphasis on learning suggests, adaptive resource management is "grounded in the admission that humans do not know enough to manage

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[6] J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L. REV. 424, 424 (2010).

[7] Robert L. Glicksman, *Ecosystem Resilience to Disruptions Linked to Global Climate Change: An Adaptive Approach to Federal Land Management*, 87 NEB. L. REV. 833, 869 (2009).

[8] AM FOR RESOURCE STEWARDSHIP, *supra* note 3, at 16.

[9] *See* HOLLING, *supra* note 3, at 39-119; J.B. Ruhl, *Regulation by Adaptive Management—Is it Possible?*, 7 MINN J.L., SCI & TECH 21, 28 (2005).

[10] AM FOR RESOURCE STEWARDSHIP, *supra* note 3, at 19.

[11] HOLLING, *supra* note 3, at 137.

ecosystems."[12] Approaching resource management adaptively therefore requires systematically recognizing unpredictability, considering future possibilities, and pursuing objectives in a manner that is flexible and subject to revision through iterative learning processes.[13] Adaptive management accordingly assumes uncertainty as its most basic premise, and makes resolving that uncertainty its central goal.[14]

The process of adaptive management is less formal than laboratory science, but more formal than mere trial and error.[15] Adaptively managing resources requires systematically considering alternative decisions, predicting the consequences of those decisions, assessing the accuracy of predictions, and revising future projections based upon lessons learned.[16] Predicting outcomes and assessing prediction accuracy provide the signals to revised understandings of system functions and, thus, future management decisions.[17] In this way, adaptive management creates a systematic response to the need for increased predictive capacity. And through the iterative process, management itself evolves.[18]

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[12] Kai N. Lee, *Appraising Adaptive Management*, 3 CONSERVATION ECOL. (1999), http://www.ecologyandsociety.org/vol3/iss2/art3/. The incongruity of limited human knowledge with current approaches to environmental assessment is discussed *infra* at 72-75.

[13] Ruhl, *supra* note 3, at 20.

[14] HOLLING, *supra* note 3, at 137. The "heart" of adaptive management, according to Professor Holling, is "an interactive process using techniques that not only reduce uncertainty but also benefit from it." *Id.* at 9.

[15] AM FOR RESOURCE STEWARDSHIP*, supra* note 3, at 22.

[16] AM FOR RESOURCE STEWARDSHIP, *supra* note 3, at 22.

[17] *Id.* at 22.

[18] J.B. Ruhl, *General Design Principles for Resilience and Adaptive Capacity in Legal Systems—With Applications to Climate Change Adaptation*, 89 N.C. L. REV. 1373, 1390 (2011).

There is no "cookbook" for adaptive management.[19] Although adaptive management is context specific, the following are nonetheless important steps in the adaptive management process: (1) problem definition, (2) management goal determination, (3) baseline assessment, (4) model development, (5) future action selection, (6) implementation, (7) monitoring, and (8) evaluation.[20] The process is not a discrete set of actions, but rather a continuous loop, through which knowledge gained from experience feeds back into the decision-making process.[21] In this way, adaptive management processes are essentially "monitoring-adjustment frameworks that allow incremental policy and decision adjustments at the 'back end,' where performance results can be evaluated and the new information can be fed back into the ongoing regulatory process."[22] As a result of the constant evaluation and adjustment, adaptive management "is somewhat analogous to surfing, where the waves are constantly moving under one's board."[23]

Adaptive management's focus on learning through experience "is not really much more than common sense."[24] It is accordingly unsurprising that although C.S. Holling introduced these iterative principles to environmental

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[19] HOLLING, *supra* note 3, at 38.

[20] Ruhl, *supra* note 18, at 1390 (internal citation omitted); *see also* AM FOR RESOURCE STEWARDSHIP, *supra* note 3; Daniel Schramm & Akiva Fishman, *Legal Frameworks for Adaptive Natural Resource Management in a Changing Climate*, 22 GEO. INT'L ENVTL. L. REV. 491, 492 (2010).

[21] HOLLING, *supra* note 3.

[22] J.B. Ruhl, *Regulation by Adaptive Management—Is it Possible?,* 7 MINN. J. L., SCI. & TECH. 21, 30 (2005).

[23] John D. Leshy, *Federal Lands in the Twenty-First Century*, 50 NAT. RESOURCES J. 111, 126 (2010).

[24] HOLLING, *supra* note 3, at 136.

management in 1978, adaptive management has interdisciplinary roots. Holling acknowledged the use of adaptive management in industry and engineering,[25] and others have recognized its application in macroeconomics, organizational behavior, policy analysis, and other disciplines.[26] The many applications of adaptive management may owe their existence to the fact that the method mimics the American philosophical tradition of epistemological pragmatism attributed to William James and Oliver Wendell Holmes, among others.[27] Philosophical pragmatism involves pursuing knowledge in a way that is "self-correcting, based in experience, but also involving interpretation and theory-building,"[28] and thus closely resembles adaptive management's focus on experiential learning through a process of action, monitoring, evaluation, and adjustment.

Although resource managers have embraced adaptive management,[29] practice is yet to deliver adaptive management's theoretical ideals of improved learning and decision-making.[30] Resource management agencies have largely ignored the critical implementation details of the adaptive

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[25] HOLLING, *supra* note 3, at 136-37.

[26] AM FOR RESOURCE STEWARDSHIP, *supra* note 3, at 19, 28.

[27] BRYAN G. NORTON, SUSTAINABILITY: A PHILOSOPHY OF ADAPTIVE ECOSYSTEM MANAGEMENT 49-62 (2005); Ryan Plummer & John Fitzgibbon, *Connecting Adaptive Co-Management, Social Learning, and Social Capital Through Theory and Practice*, *in* ADAPTIVE CO-MANAGEMENT: COLLABORATION, LEARNING, AND MULTI-LEVEL GOVERNANCE 38, 39 (Derek Armitage, Fikret Berkes, & Nancy Doubleday eds. 2007) (tracing the "roots" of social learning to John Dewey's pragmatism).

[28] NORTON, *supra* note 27, at 49.

[29] *See supra* notes 1 and 2.

[30] HOLLY DOREMUS ET AL., MAKING GOOD USE OF ADAPTIVE MANAGEMENT 3 (Ctr. for Progressive Reform White Paper #1104, 2011).

learning process,[31] such as monitoring and reassessment,[32] and instead simply condensed adaptive management into the "mantra" of "learning while doing" without providing any indication of how to do so.[33] As a result, in practice, adaptive management "has been watered down to a weak lemonade of ad hoc contingency planning."[34] Such a "wait-and-see approach"[35] fails to deliver the increased knowledge that is the aim of adaptive management.[36] It thereby trades the perceived certainty of traditional front-end decision-making for the uncertainty of adaptive management without promising any future learning in return.[37] This discretion for future "adaptive" management without detailed processes and objectives can be used as an excuse for agencies to delay indefinitely politically challenging decisions.[38]

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[31] Ruhl & Fischman, *supra* note 6, 431-33, 435-36 (showing the deficiencies in federal agency adaptive management policies); PANEL ON ADAPTIVE MANAGEMENT FOR RESOURCE STEWARDSHIP, ADAPTIVE MANAGEMENT FOR WATER RESOURCE PROJECT PLANNING 57-58 (Nat'l Academies Press 2004) (examining deficiencies in adaptive management in Everglades and on Missouri River) [hereinafter "AM FOR RESOURCE STEWARDSHIP"].

[32] Alejandro E. Camacho, *Transforming the Means and Ends of Natural Resource Management*, 89 N.C. L. REV. 1405, 1415-16 (2011); Ruhl & Fischman, *supra* note 6, at 441-42; DOREMUS, ET AL., *supra* note 30, at 3; AM FOR RESOURCE STEWARDSHIP, *supra* note 31, at 57-58; Carl J. Walters, *Is Adaptive Management Helping to Solve Fisheries Problems?*, 36 AMBIO 304 (2007); W. H. Moir & W. M. Block, *Adaptive Management on Public Lands in the United States: Commitment or Rhetoric?*, 28 ENVTL. MGMT. 141 (2001).

[33] Ruhl & Fischman, *supra* note 6, at 432; *see also* DOREMUS ET AL., *supra* note 30, at 3 (noting the imprecise policy definitions of adaptive management).

[34] Ruhl & Fischman, *supra* note 6, at 428; E. Sabine et al., *Adaptive Management: A Synthesis of Current Understanding and Effective Application*, 5 ECOL. RESTORATION & MGMT. 177 (2004) (observing that in practice adaptive management amounts to ad hoc responses to inadequate planning and monitoring); *see also* DOREMUS ET AL., *supra* note 30, at 3 (agency practice of adaptive management "often falls well short of the scientific ideal").

[35] Ruhl & Fischman, *supra* note 6, at 434.

[36] Ruhl & Fischman, *supra* note 6, at 442-43.

[37] Ruhl & Fischman, *supra* note 6, at 443.

[38] Holly Doremus, *Adaptive Management as an Information Problem*, 89 N.C. L. REV. 1454, 1457 (2011); *see also* DOREMUS ET AL., *supra* note 30, at 3, 5.

Collaborative Governance

The progressive ideal of scientific management holds that more science and better technology will solve management problems.[39] In accordance with this ideal, wildlife managers traditionally focus on saving nature through science and avoiding getting bogged down in "local politics."[40] This separation of the natural and scientific from the human and political—imagining there to be a "nature 'out there'"[41]—is unrealistic.

Science-based management, whether adaptive or not, cannot rise above human influences on wildlife management. As Aldo Leopold famously observed, "Conservation is a state of harmony between men and land." [42] Science cannot now, nor will it ever, answer all of the questions.[43] Human values—politics—will often fill the scientific void.[44] Sometimes political preferences will prevail over science. Moreover, wildlife management is, at its core, about managing human impacts on the natural world.[45] Humans

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[39] *Community Values in Conservation*, *in* RECONSTRUCTING CONSERVATION: FINDING COMMON GROUND 279-80 (Ben A. Minteer & Robert E. Manning eds. 2003).

[40] *Conservation and Culture, Genuine and Spurious*, *in* RECONSTRUCTING CONSERVATION, *supra* note 39, at 59.

[41] *Id.* at 59.

[42] A SAND COUNTY ALMANAC 207 (1986 ed.).

[43] *Community Values in Conservation*, *supra* note 39, at 280; *see also* Charles G. Curtin, *Integrating and Applying Knowledge from Community-Based Collaboratives, in* COMMUNITY-BASED COLLABORATION: BRIDGING SOCIO-ECOLOGICAL RESEARCH AND PRACTICE 19, 39 (E. Franklin Dukes et al. eds. 2011) (noting that "science can only address those questions that can be accurately measured or manipulated").

[44] For example, the precautionary principle embraces a value judgment in the face of scientific uncertainty.

[45] Daniel J. Decker et al., *Conclusion: What Is Wildlife Management?*, *in* WILDLIFE AND SOCIETY: THE SCIENCE AND HUMAN DIMENSIONS 315, 324 (Michael J. Manfredo et al. eds. 2009) (internal citation omitted) (citing humans, wildlife, habitats, and their interactions as the key elements of wildlife management systems). Also see *id.* at 324, defining wildlife management as "the set of processes and actions necessary to enable coexistence of humans and wildlife on a sustainable basis."

influence natural systems directly through their actions and indirectly through participation in public processes affecting resource management. The science that guides management is itself "as much a social process as a biological one."[46]

To sew together fragmented decision-making structures and better account for the human aspects of resource management,[47] many have advocated for participatory alternatives to the traditional, top-down management model. Referred to variously as "co-management,"[48] "collaborative governance,"[49] and "new governance,"[50] among others, these theories advance institutionalized stakeholder collaboration based on common interest.[51] Emphasizing stakeholder participation to resolve shared problems, collaborative governance, like adaptive management, is essentially a learning process;[52] it "is a means, not an end."[53]

To some, collaborative management might sound idealistic,[54] and in many cases it will be. While collaborative governance might not be the

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[46] Curtin, *supra* note 43, at 38.

[47] *See, e.g.*, Perry J. Brown, *Introduction: Perspectives on the Past and Future of Human Dimensions of Fish and Wildlife*, *in* WILDLIFE AND SOCIETY: THE SCIENCE OF HUMAN DIMENSIONS 1 (Michael J. Manfredo et al eds., 2009).

[48] *E.g.*, ADAPTIVE CO-MANAGEMENT: COLLABORATION, LEARNING, AND MULTI-LEVEL GOVERNANCE (Derek Armitage et al. eds., 2007).

[49] *E.g.*, COLLABORATIVE GOVERNANCE OF TROPICAL LANDSCAPES (Carol J. Pierce Colfer & Jean-Laurent Pfund eds., 2011).

[50] *E.g.*, Cameron Holley & Neil Gunningham, *Natural Resources, New Governance and Legal Regulation: When Does Collaboration Work?*, 24 NEW ZEALAND U.L. REV. 309 (2011).

[51] *See supra* notes 48-51.

[52] JAMES E. AUSTIN, THE COLLABORATION CHALLENGE 138-40 (2000).

[53] RUSSELL M. LINDEN, WORKING ACROSS BOUNDARIES: MAKING COLLABORATION WORK IN GOVERNMENT AND NONPROFIT ORGANIZATIONS 175 (2002).

[54] *Id.*

"panacea"[55] for resource management, both theory and practice have shown that under "the right circumstances, ordinary people have a substantial capacity to overcome differences and discover common ground."[56] Political scientist Robert Axelrod, for example, has shown that cooperation based upon reciprocity can lead self-interested participants out of the prisoner's dilemma so long as long-term interaction is likely,[57] as well as how different factors influence cooperation.[58] In practice, examples of collaboration abound, demonstrating both failures and successes.[59]

Several necessary elements limit the realm in which collaborative management techniques can succeed, ignorance of which can explain many failed collaborative efforts. First, there must exist a higher, common interest or problem around which actors are willing to organize—a shared purpose or goal that is meaningful to the parties but which they cannot achieve on their own.[60] Because people are generally risk averse and wary of opportunities

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[55] *Community Values in Conservation*, *supra* note 39, at 290.

[56] Daniel Kemmis & Matthew McKinney, *Collaboration as an Emerging Form of Democracy*, NAT'L CIVIC REV. (Summer 2011), at 1, 4, *available at* http://www.ncl.org/pdfs/100-2/Kemmis.McKinney.pdf.

[57] ROBERT AXELROD, THE EVOLUTION OF COOPERATION 27-54 (2006 rev. ed.).

[58] *See generally* ROBERT AXELROD, THE COMPLEXITY OF COOPERATION (1997). Professor Axelrod shows, for example, that voluntary membership in a group helps norm promotion, *id.* at 59-60, and that there exists an incentive equilibrium point for member participation in a group, *id.* at 96.

[59] *See, e.g.*, ADAPTIVE GOVERNANCE (Ronald D. Brunner et al. eds., 2005); Lawrence Susskind et al., *Collaborative Planning and Adaptive Management in Glen Canyon: A Cautionary Tale*, 35 COLUMBIA J. ENVTL. L. 1 (2010).

[60] LINDEN, *supra* note 53, at 60, 123-25; AUSTIN, *supra* note 52, at, 175.

with uncertain outcomes,[61] urgent and narrowly defined problems are most susceptible to collaborative solutions.[62]

Second, for collaborative efforts to successfully address a common problem, there must be stakeholders "who strongly believe that a collaborative effort is in their interest, who want to support it, and who have influence over the parties involved."[63] The commencement of a collaborative effort therefore requires "an understanding of stakeholders' views, perceptions, attitudes, and values[.]"[64]

Stakeholder collaboration, in turn, must proceed through an open, credible decision-making process.[65] People value a fair process nearly as much as a favorable outcome, and understand fairness as equal treatment of all parties.[66] The collaborative process must therefore be built on joint ownership, agreed upon norms or ground rules, transparency,[67] and communication,[68] and it must connect individuals to the larger objective,[69] while also making performance visible and accountability real.[70] The

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[61] *The Legitimacy of Collaboration: How People Decide Whether the Process Is Fair*, *in* COMMUNITY-BASED COLLABORATION, *supra* note 43, at 160, 175.

[62] William D. Leach, *Building a Theory of Collaboration*, *in* COMMUNITY-BASED COLLABORATION, *supra* note 43, 146, 172; LINDEN, *supra* note 53, at 75.

[63] LINDEN, *supra* note 53, at 131.

[64] Irene Ring, *Toward a Framework for Integrating Human Dimensions in Wildlife Management*, *in* WILDLIFE AND SOCIETY, *supra* note 47, at 90, 93.

[65] LINDEN, *supra* note 53, at 82-84.

[66] *The Legitimacy of Collaboration*, *supra* note 61, at 160, 162. People will view a process favorably if the process treats participants with civility and respect, and participation meaningfully influences the outcome. *Id.* at 164.

[67] LINDEN, *supra* note 53, at 82-84; *Legitimacy of Collaboration*, *supra* note 61, at 166.

[68] AUSTIN, *supra* note 52, at 180.

[69] LINDEN, *supra* note 53, at 114-16.

[70] LINDEN, *supra* note 53, at 119-23.

decision-making process must provide common methods for resolving stakeholder conflict that establish criteria for making trade-offs and allow opportunities for learning in conflict resolution.[71]

Beyond common interests, stakeholder support, and properly crafted decision-making processes, successful collaborative efforts also require trust.[72] At the outset, stakeholders must trust that participation in a collaborative effort will be worthwhile.[73] Then the stakeholders must trust one another to act in good faith throughout the collaborative process.[74] That trust, in turn, can help the collaborative effort to move forward in times of doubt.[75] While trust is a necessary condition for successful collaboration, collaborative efforts can also help to build trust.[76] In this way, the

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[71] Jeff Weiss & Jonathan Hughes, *Want Collaboration?*, *in* COLLABORATING EFFECTIVELY 65, 71-82 (2011).

[72] LINDEN, *supra* note 53, at 41-42; AUSTIN, *supra* note 52, at 127-31; Maria E. Fernandez-Gimenez & Heidi L. Ballard, *How CBCs Learn: Ecological Monitoring and Adaptive Management*, *in* COMMUNITY-BASED COLLABORATION, *supra* note 43, at 45, 55; Daniel Schramm & Akiva Fishman, *Legal Frameworks for Adaptive Natural Resource Management in a Changing Climate*, 22 GEO. INT'L ENVTL. L. REV. 491, 513 (2010).

[73] "Trust" in this sense might be reducible to cost-benefit analysis. A corporation might consider whether a collaborative effort will help to head off trouble, accelerate innovation, shape legislation, or establish industry standards. MICHAEL YAZIJI & JONATHAN DOH, NGOS AND CORPORATIONS: CONFLICT AND COLLABORATION 129-34 (2009); *see also* AXELROD, *supra* note 58, at 96. The utility to a firm of joining a collaborative effort increases with group size and decreases with the presence of rivals. AXELROD, *supra* note 58, at 96.

[74] *The Economics of Collaboration: Whether the Process is Worthwhile*, *in* COMMUNITY-BASED COLLABORATION, *supra* note 43, at 167, 175; Fernandez-Gimenez & Ballard, *supra* note 72, at 55.

[75] LINDEN, *supra* note 53, at 94; *see also id.* at 60 (describing trust as "the glue for most collaborative ventures").

[76] Steven L. Yaffee & Julia M. Wondolleck, *Making Collaboration Work: Lessons from a Comprehensive Assessment of over 200 Wide-Ranging Cases of Collaboration in Environmental Management*, VOL. CONSERVATION BIO. IN PRACTICE 17, 18 (describing how a joint learning process built trust among competing interests); Gregg B. Walker & Susan L. Senecah, *Collaborative Governance: Integrating Institutions, Communities, and People*, *in* COMMUNITY-BASED COLLABORATION, *supra* note 43, 111, 135 (describing processes designed to increase trust); LINDEN, *supra* note 53, at 95-104 (describing techniques for relationship building).

relationship is reciprocal—trust facilitates collaboration, which in turn facilitates trust.

Models of collaborative governance can be organized according to participation allowed and allocation of decision-making authority. Participatory structures are either open or closed. In "open" collaboratives, anyone can offer input. [77] By contrast, only a select group can participate in a "closed" collaborative.[78] Decision-making is similarly divided among flat and hierarchical organization. In "flat" collaborative efforts, each participant shares equal decision-making authority,[79] while in "hierarchical" collaboratives, a predefined authority identifies problems and selects solutions.[80]

Different costs and benefits attend the different models of collaboration. An "open" participation model, for instance, will attract the broadest range of ideas, while a "closed" model will deliver select knowledge from a precise domain.[81] An "open-flat" model, which amounts to consensus decision-making, might produce durable solutions, but will be slow to do so.[82]

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[77] Gary P. Pisano & Roberto Verganti, *Which Kind of Collaboration is Right for You?*, *in* COLLABORATING EFFECTIVELY, *supra* note 71, at 17, 17.

[78] *Id.*

[79] *Id.*

[80] *Id.* Although not intuitively "collaborative," notice-and-comment rulemaking is an open-hierarchical decision-making structure. Any person can offer input, but the administrative agency defines the problem and selects the solution.

[81] *Id.* at 20-21.

[82] Wikipedia provides an example of an open-flat model of collaboration. *Compare id.* at 17 *with* JOSEPH MICHAEL REAGLE, JR., GOOD FAITH COLLABORATION: THE CULTURE OF WIKIPEDIA 103-11 (2010). As Reagle observes of Wikipedia, "consensus can take a long time, be frustrating in circumstances where there is little hope of agreement, and, when understood as unanimity, can give a self-interested minority veto power over group decisions." *Id.* at 111.

By contrast, a closed-hierarchical model will produce quick decisions, the durability of which will suffer from the more limited participation of a closed decision-making model.

When properly implemented, collaborative governance offers many benefits by recognizing the human elements in resource management. Perhaps most importantly, collaborative institutions can provide a forum to close political and jurisdictional divisions through participation in decision-making. Complex problems that overlie traditional boundaries in the "nobody in charge"[83] world of political and jurisdictional fragmentation, such as wildlife management, may therefore benefit greatly from collaborative governance.[84] The collaborative decision-making process can also create more durable management decisions by generating stakeholder buy-in,[85] while at the same time providing a mechanism for resolving conflict.[86] Both function to minimize costly litigation and according management action delays. Collaborative decision-making can also be designed to allow more meaningful

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[83] LINDEN, *supra* note 53, at 14.

[84] Karen E. Firehock, *The Community-Based Collaborative Movement in the United States*, *in* COMMUNITY-BASED COLLABORATION, note 43, at 1, 4.

[85] Decker, *supra* note 45, at 317.

[86] *Community Values in Conservation*, *supra* note 39, at 290 (internal citations omitted); E. Franklin Dukes, *The Promise of Community-Based Collaboration: An Agenda for an Authentic Future*, *in* COMMUNITY-BASED COLLABORATION, *supra* note 43, at 189, 206 (describing "cultured conflict," in which stakeholders "listen to one another, take each participant's perspective seriously, and attempt to address the concerns of each participant.").

democratic participation than the open-hierarchical notice-and-comment participation the administrative process normally provides.[87]

Like adaptive management, collaborative governance has suffered from a shortage of implementation guidance. As a result, information sharing is minimal, shared decision-making opportunities rare, and intergovernmental learning even less common.[88]Politically and jurisdictionally fragmented decision-makers simply lack direction on how to interact in the regulatory commons, as well as an incentive for doing so. The lack of direction and incentives present arguably the greatest challenge for collaborative decision-making efforts.

Recent efforts, however, could help to bridge the collaborative divides. In a 2009 order, Interior Secretary Salazar established two important, interacting programs to foster collaboration among resource managers.[89] The National Climate Change and Wildlife Science Center, along with its eight regional climate science centers, provides climate change science support to resource managers, as well as an infrastructure for sharing information.[90] These scientific centers can help to feed the information hungry front-end assessment stage of adaptive management. Landscape Conservation

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[87] As Kemmis & McKinney note, public hearings and written comments "almost never create an opportunity for anything resembling democratic problem solving." *See supra* note 56, at 4. Kemmis & McKinney argue that collaboration is a species of democracy related to both deliberative and direct democracy. *Id.* at 9.

[88] Camacho, *supra* note 32, at 1424.

[89] U.S. Dep't of Interior, Secretarial Order 3289 § 3(b), (c).

[90] U.S. Geologic Survey, National Climate Change and Wildlife Science Center, https://nccwsc.usgs.gov/ (Oct. 18, 2012). The regional centers are organized by U.S. geographic region: Alaska, North Central, Northeast, Northwest, Pacific Islands, South Central, Southeast, and Southwest. *Id.*

Cooperatives provide the mechanism for deploying the technical expertise of the science centers, serving as a forum for states, tribes, federal agencies, and nongovernmental entities to strategically conserve wildlife habitat on landscape scales.[91] Although it is too early to measure the effectiveness of these efforts in advancing collaboration, the agency has built substantial collaborative infrastructures in a relatively short time period.[92]

Collaborative management is not without its critics. Professor Coggins, for example, has argued that the federal government owns the federal lands must accordingly manage them according to national, not local, preferences.[93] In other words, some view collaboration as *anti*-democratic to the extent that a democratic majority has not approved of it.[94] The same argument can be made against disproportionate influence state resource planning has in BLM, Forest Service, and Fish and Wildlife Service decision-making.[95]

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[91] U.S. Fish & Wildlife Service, Strategic Habitat Conservation, Landscape Conservation Cooperatives, http://www.fws.gov/landscape-conservation/lcc.html (Aug. 28, 2012). Each such effort appears to have taken the first step toward closing the jurisdictional divides. The Great Plains initiative, for example, includes 7 federal agencies, 6 states, and 5 nongovernmental organizations. Great Plains Landscape Conservation Cooperative, Partnership-Based Initiative, http://www.greatplainslcc.org/partners/ (last visited Nov. 6, 2012).

[92] *See, e.g.*, California Landscape Conservation Cooperative, http://californialcc.org/ (Oct. 12, 2012); South Atlantic LCC, http://www.southatlanticlcc.org/ (last visited Nov. 6, 2012); Great Basin Landscape Conservation Cooperative, http://www.blm.gov/nv/st/en/prog/more_programs/GBLCC.html (Oct. 29, 2012); Great Plains Landscape Conservation Cooperative, http://www.greatplainslcc.org/ (last visited Nov. 5, 2012).

[93] Cameron Coggins, *Of Californicators, Quislings, and Crazies: Some Perils of Devolved Collaboration*, *in* ACROSS THE GREAT DIVIDE 163, 170-71 (Phillip Brick et al. eds., 2001).

[94] Kemmis & McKinney, *supra* note 56, at 10.

[95] *See* 43 U.S.C. § 1712(c) (2011); 16 U.S.C. § 1604(a), (b) (2011); 16 U.S.C. § 668dd(e)(1)(A)(iii) (2011).

Synergies

Although often implemented and analyzed independently, collaborative and adaptive processes are not only compatible, but also complimentary. Stakeholder involvement—the essence of collaboration—is "essential to adaptive management."[96] Diverse participants can offer unique perspectives in the adaptive learning process,[97] thereby increasing the information that guides management decisions and leads to more effective actions.[98]

In the wildlife management context, collaboration can create a forum for sharing technical and local knowledge necessary to facilitate better adaptive management. Federal land managers can share their understanding of the vast lands that serve as wildlife habitat, while states can contribute their knowledge of many of the intricacies of particular wildlife populations. Local governments, nongovernmental organizations, industry, and others will also often be able to offer valuable insights into wildlife management.

Certain technical disciplines, such as biology or geography, likely will be widely represented among federal, state, and private wildlife management

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[96] AM FOR RESOURCE STEWARDSHIP, *supra* note 3, at 27; *see also* Lawrence Susskind et al., *Collaborative Planning and Adaptive Management in Glen Canyon: A Cautionary Tale*, 35 COLUMBIA J. ENVTL. L. 1, 55 (2010) (stating that effective resource management "requires the development of an appropriate organization infrastructure that promotes stakeholder dialogue and agency learning"); J.B. Ruhl, 7 MINN. J.L. SCI. & TECH. at 27 (noting that diversity in stakeholder interests can "increase[e] the chances of creative, multifaceted regulatory responses").

[97] Firehock, *supra* note 84, at 3; Curtin, *supra* note 43, at 19.

[98] For example, in one case, local knowledge of fishermen derived through simple observation contributed substantially to developing a plan to recover fishery stocks. Curtin, *supra* note 43, at 22-26.

collaborators. The collaborative process can further adaptive learning by providing opportunities for collective analysis of problems among disciplinary experts, who would in turn share their specialized expertise with the broader collaboration. Other important areas of technical expertise (e.g., climatology) might not be as widely represented, though efforts like the National Climate Change and Wildlife Science Center could help to fill those gaps. Recognizing and filling pertinent technical voids in the collaborative effort is a necessary component of successful adaptive management.

Collaboration can also serve a dispute resolution function in the adaptive management process, "encourage[ing] stakeholders to bound disputes and discuss them in an orderly fashion while environmental uncertainties are being investigated and better understood."[99] The adaptive process of learning by experience in turn helps to facilitate collaboration, focusing participants on solving shared problems and "reduc[ing] decision-making gridlock by making it clear that decisions are provisional, that there is often no 'right' or 'wrong' management decision, and that modifications are expected."[100]

Wildlife management, especially endangered species management and analysis of impacts on wildlife, tends to get embroiled in extended litigation

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[99] Curtin, *supra* note 43, at 20.
[100] Curtin, *supra* note 43, at 20.

gridlock.[101] Such litigation can delay management action implementation and give rise to conflicting management decisions. Those delays and conflicts create uncertainty and frustrate business investment.[102] Bringing all of the relevant stakeholders to the table in a collaborative learning process can help managers generate buy-in and therefore create more durable management decisions that are less likely to be subject to litigation. Collaborative structures can thus help create more stable investment environments that may be a worthwhile trade for the short-term uncertainty inherent in adaptive learning.

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[101] *See, e.g.*, Ben Van der Meer, *More Litigation over Yuba River Fish*, APPEAL DEMOCRAT (Mendocino), Jan. 29, 2013 (describing prolonged endangered species litigation), http://www.appeal-democrat.com/articles/bv0130syrcl-122927--.html.

[102] *See, e.g.*, Todd Woody, *Solar Energy Faces Test on Greenness*, N.Y. TIMES, Feb. 23, 2011, http://www.nytimes.com/2011/02/24/business/energy-environment/24solar.html?pagewanted=all (describing lawsuit to block construction of multibillion dollar solar energy project

VI. INSTITUTIONALIZING COLLABORATIVE AND ADAPTIVE WILDLIFE MANAGEMENT

For wildlife managers facing the complexities of a changing climate—habitat shifts, disease emergence, and evolving biology—adaptive and collaborative management techniques offer an appealing way to systematically confront and resolve uncertainty, and to sew together jurisdictional, ecological, and political fragments in land and wildlife management. Identifying a problematic unknown—such as how grizzly bears will react to white bark pine decline in the Yellowstone ecosystem—and then rigorously subjecting that question to the adaptive process provides a way to respond to the many ecological questions climate change will pose. Bringing together all of the stakeholders in such a shared problem can increase the resources available to fuel the iterative process, provide a forum for reconciling science and values, and allow for more effective and ecologically realistic design and implementation of management actions.

The federal land management agencies are particularly well-suited to collaboratively and adaptively manage wildlife habitat. Their statutory responsibilities provide numerous opportunities—through planning, environmental assessment, and site-specific actions—to implement collaborative and adaptive processes to manage the lands wild creatures inhabit. However, as past experiences show, the federal land managers must more effectively implement collaborative and adaptive management. To do so, they should thoroughly assess the propriety of collaboration and adaptation in each instance, and sufficiently design and commit to carrying out collaborative and adaptive processes.

Enacting new collaborative and adaptive management legislation could force federal land managers to more effectively implement both management techniques. With legislation could come the benefit of judicial review of implementation and, accordingly, increased accountability. However, legislation might be difficult to obtain,[1] and could unnecessarily constrain federal land managers' ability to experiment with the design and implementation of novel collaborative and adaptive techniques. To maintain flexibility to experiment while ensuring accountability for effective implementation, federal land managers should take ownership of the collaborative and adaptive project and make binding commitments in decision documents, such as environmental assessments, to carry out adequately the collaborative and adaptive processes. In so doing, agencies can remove barriers to judicial review, and thereby increase the likelihood of appropriate and effective implementation.

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[1] *See, e.g.*, Ezra Klein, *14 Reasons Why This Is the Worst Congress Ever*, WASH. POST WONKBLOG, July 13, 2012 (noting the consistent downward trend in congressional productivity since 1947), http://www.washingtonpost.com/blogs/wonkblog/wp/2012/07/13/13-reasons-why-this-is-the-worst-congress-ever/.

Convincing federal land managers to relinquish discretion and make binding, judicially reviewable commitments will be a difficult sell. As a general rule, "It's great to be an accountability *holder*."[2] But, "It's not so much fun to be an accountability *holdee*."[3] Land management agencies might accordingly fear that "if someone is holding them accountable, two things can happen: When they do something good, nothing happens. But when they screw up, all hell can break loose."[4]

The key to unlocking this psychological fear lies in the considerable control public land managers have in defining what accountability means in the context of collaborative and adaptive management.[5] Land managers can mold the collaborative and adaptive processes by establishing reasonable expectations for stakeholders, accurately identifying barriers to achieving management objectives, and negotiating for appropriate terms under which the agency can be held to account.[6] Accountability therefore need not be seen as all sticks and no carrots. Rather, land management agencies can use their discretion to ensure that limits to discretion create fair and reasonable prospects of success.[7] Taking such steps toward accountability for management goals can in turn "help[] public managers acquire the political

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[2] ROBERT D. BEHN, RETHINKING DEMOCRATIC ACCOUNTABILITY 2 (2001).
[3] *Id.*
[4] *Id.* at 3. In this sense, accountability "means punishment….the public humiliation of being grilled by a hostile legislator, of being sued by an aggressive lawyer, …or being defamed by an investigatory journalist." *Id.*
[5] *Id.* at 122.
[6] *Id.*
[7] *Id.* ("public managers ought to be accountable for suggesting very specific ways to create accountability").

support necessary to accomplish these objectives."[8]

The federal land managers' efforts should themselves be exercises of adaptive management, testing hypotheses about the implementation of adaptive and collaborative management methods.[9] Resource managers might not be ready for a broad deployment of collaborative and adaptive management,[10] and those methods will not be appropriate in every management context.[11] However, managers must nonetheless focus on developing new decision-making structures to address the stresses of climate change.[12]

Why Wildlife?

The problems of fragmentation and scientific uncertainty are particularly acute for wildlife managers, and will become increasingly so in a changing climate. Although fragmentation and scientific uncertainty are symptoms that prompt collaborative and adaptive prognoses, those conditions alone do not necessitate or even counsel the implementation of collaborative and adaptive management, at least not with present implementation

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[8] *Id.* (internal citation omitted).

[9] *See* J.B. Ruhl, *Regulation by Adaptive Management—Is it Possible?*, 7 MINN. J. L., SCI. & TECH. 21, 54 (2005) ("the challenge for administrative law and policy is to devise and test new institutions and instruments of policy implementation that allow agencies to use adaptive management while ensuring adequate agency accountability.").

[10] *Cf. id.* at 55 ("We are far from ready to draft the National Adaptive Management Act!").

[11] *See* discussion *infra* at 117-19 and accompanying footnotes.

[12] *See* Alejandro E. Camacho, *Transforming the Means and Ends of Natural Resource Management*, 89 N.C. L. REV. 1405, 1406 (2011).; J.B. Ruhl, *General Design Principles for Resilience and Adaptive Capacity in Legal Systems—With Applications to Climate Change Adaptation*, 89 N.C. L. REV. 1373 (2010).

limitations. Stated simply, it is not just the 'how' of collaborative and adaptive management, but also the 'when.'

Adaptive management should be implemented only when there are information gaps, good prospects for learning, and opportunities for adjustment.[13] Information gaps must be related to overall management goals and closeable on management-relevant time scales.[14] The information gap must relate to a management action that is susceptible to adjustment over time to respond to new information.[15] Although wildlife managers will often have good prospects for learning about uncertainties, the potential will in each case be tied to the nature of the uncertainty, which can range from the general future unknown to particular questions about the effects of management actions.[16] Finally, decision-makers must have the flexibility to pursue alternative policies based on new information.[17]

While the propriety of implementing adaptive management is necessarily contextual, management of wild animals will often meet the prerequisites for adaptive management. Wildlife management is riddled with information gaps that concern not only general future unknowns, but also very specific, present management uncertainties. A recent issue of a leading wildlife management periodical included research, for example, on the effects

[13] Holly Doremus, *Adaptive Management as an Information Problem*, 89 N.C. L. REV. 1454, 1466-77 (2011).
[14] *Id.* at 1467-68.
[15] *Id.* at 1469.
[16] *Id.* at 1470-73.
[17] *Id.* at 1476.

of prescribed burns on bird nests,[18] greater prairie chicken demography,[19] and turtle mortality.[20] While this sampling indicates the breadth and detail of uncertainty in wildlife management, it is also misleading because it suggests that information gaps in wildlife management are narrow. Some of the most basic information necessary to manage wildlife is lacking: for example, the role that millions[21] of hunters' harvests play in waterfowl population dynamics remains uncertain.[22]

These kinds of information gaps relate to overall wildlife management goals. For example, maintaining sustainable harvests of waterfowl, which relates directly to the role of hunter harvests in waterfowl populations, is a central management goal for state and federal wildlife managers. Opportunities to learn about uncertainties will frequently present themselves to wildlife managers through the observation and monitoring that is already a primary management tool. The nature and extent of the learning opportunity will, however, depend not only on the resources available to address the information gap, but also the time frame over which the problem

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[18] Ashley M. Long et al., *Effects of Prescribed Burning on Avian Nest Survival in the Southern Great Plains*, 76 J. WILDLIFE MGMT. 899 (2012).

[19] Lance B. McNew et al., *Demography of Greater Prairie-Chickens: Regional Variation in Vital Rates, Sensitivity Values, and Population Dynamics*, 76 J. WILDLIFE MGMT. 987 (2012).

[20] James C. Cureton II and Raelynn Deaton, *Hot Moments and Hot Spots: Identifying Factors Explaining Temporal and Spatial Variation in Turtle Road Mortality*, 76 J. WILDLIFE MGMT. 1047 (2012).

[21] The most recent estimate indicated that more than 2 million people hunted waterfowl annually. 2006 NATIONAL SURVEY OF FISHING, HUNTING, AND WILDLIFE-ASSOCIATED RECREATION 22 (U.S. Fish & Wildlife Svc. 2006).

[22] James S. Sedinger & Mark P. Herzog, *Harvest and Dynamics of Duck Populations*, 76 J. WILDLIFE MGMT. 1108 (2012); James D. Nichols, Fred A. Johnson, & Byron K. Williams, *Managing North American Water Fowl in the Face of Uncertainty*, 26 ANN. REV. ECOL. SYST. 177, 178 (1995).

can and should be addressed.

The Fish and Wildlife Service, like the Forest Service, must revise plans only every fifteen years,[23] while the National Park Service needs only to revise plans as necessary.[24] The iterative processes of adaptation and collaboration might in some cases require plan reassessment and revision more frequently than the statutory minimum. Other management problems might require more time than the statutory planning period to be resolved through adaptive management. Ensuring agencies provide for the review times needed to deploy adaptive and collaborative management independent of other management processes will be critical to effective implementation.[25]

Wildlife managers have relatively noteworthy flexibility to adjust decisions over time in response to new information. Much of wildlife management focuses on maintaining sustainable harvests of game species. Such a sustained-yield mandate allows management discretion to select from among management alternatives. State wildlife managers therefore regularly revise harvest restrictions. BLM and the Forest Service—land managers responsible for overseeing vast swaths of wildlife habitat—also have flexible multiple-use, sustained-yield management goals that at least in theory allow flexibility to adjust to new information produced in the iterative process.[26]

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[23] 16 U.S.C. § 668dd(e)(1)(A)(iv) (2011).

[24] 16 U.S.C. § 1a-7(b) (2011).

[25] Because planning can be contentious and resource intensive, agencies might have an incentive to wrongfully delay plan reassessment and revision.

[26] Although the multiple-use, sustained-yield mandate allows managers flexibility in appropriating resources on the public lands, allocation of limited resources can practically limit that flexibility. For example, some decisions, such as to allow the development of a

Even the most restricted wildlife management decisions can allow adequate agency flexibility to respond to new information. The Endangered Species Act, which takes a strict preservationist approach to wildlife management, has nonetheless proven to allow some room for adaptive learning.[27] So too can the dominant-use land managers respond to new information in their attempts to preserve characteristics of the land.

Wildlife management also will frequently provide an appropriate and even compelling context for implementing collaborative methods. Few other natural resources rival wildlife in the extent to which management problems span jurisdictional, political, and ecological divides.[28] Those shared problems, institutional barriers notwithstanding, provide the kind of common interest that is the most basic prerequisite for collaborative management techniques. The common interest provides a "strategic fit"[29] around which government and nongovernment interests, such as hunters, conservationists, and other resource users, can coalesce. Stakeholders frequently make clear their willingness to voluntarily participate in wildlife management decisions,

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natural gas field, have long-term effects that can limit the suitability of lands for wildlife and thereby reduce flexibility to respond to new information acquired through the adaptive process. *See, e.g.*, Emilene Ostlind, *BLM Stays Course in Wyoming Gas Patch Despite Mule Deer Decline*, HIGH COUNTRY NEWS, March 21, 2011, http://www.hcn.org/issues/43.5/blm-stays-course-in-wyoming-gaspatch-despite-mule-deer-decline.

[27] *See* Ruhl, *supra* note 9, at 39-53 (describing the Fish & Wildlife Service's habitat conservation program). Although the preservationist mandate of the Endangered Species Act allows room for adaptive learning, implementation will not be successful if the process creates too much uncertainty or too severely excludes the public from participation. *Id.*

[28] Air and water pollution also present managers with transboundary challenges. Yet for both air and water, unlike wildlife, Congress has provided solutions to address the problems' lack of respect for political borders. *See* 42 U.S.C. §§ 7408(b), 7409 (2011) (national ambient air quality standards); 33 U.S.C. § 1313 (2011) (surface water quality standards).

[29] JAMES E. AUSTIN, THE COLLABORATION CHALLENGE 3 (2000).

though that does not mean that every interest group will engage voluntarily in every collaborative process. Nonetheless, the widespread interest in and fragmentation of wildlife management suggest a good fit for collaborative processes.

Federal Deployment

Federal land management agencies provide the ideal hub for deploying collaborative and adaptive wildlife management. They collectively manage more wildlife habitat than any other entity in the United States. The legal processes that guide federal land management, as well as those applying to particular agency actions, such as NEPA and the Endangered Species Act, support implementation of collaborative and adaptive management principles. As a result, the managers of the majority of the nation's wildlife habitat are statutorily equipped to manage adaptively and collaboratively at both large and small scales.

Each of the four federal land managers is required to conserve wildlife,[30] and each agency engages in resource planning processes through which collaborative and adaptive methods can be implemented.[31] In preparing broad resource management plans, the Forest Service, BLM, and Fish and Wildlife Service each must coordinate their planning processes with

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30 16 U.S.C. § 668dd(a)(2) (requiring Fish and Wildlife Service to manage lands for the purpose of restoring wildlife habitat);

31 16 U.S.C. § 668dd(e)(1)(A)(i) (2011) (Fish & Wildlife Svc.); 16 U.S.C. § 1a-7(b) (2011) (Nat'l Park Svc.); 16 U.S.C. § 1604(a), (b) (2011) (Forest Svc.); 43 U.S.C. § 1711 (2011) (BLM).

other federal agencies, as well as affected state and local governments, which provides a statutory basis for collaborative decision-making.[32] Those same three agencies also are required to monitor and inventory resources, the results of which can provide the information baselines necessary to frame shared problems and implement adaptive learning processes.[33] Although not required by statute, the Park Service management policy similarly supports resource inventories and monitoring, as well as coordination with other stakeholders.[34]

The Forest Service's new planning regulations, which recognize climate change resilience and collaboration as necessary components of forest management,[35] provide one example of how comprehensive land management planning can support collaborative and adaptive management. For all new and revised management plans, the rules require a front-end assessment that gathers relevant information in coordination with stakeholders in the form of a public report.[36] The assessment must identify and evaluate information relevant to ecological "stressors, such as natural succession, wildland fire, invasive species, and climate change,"[37] as well as "threatened, endangered, proposed and candidate species, and potential species of conservation

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[32] *See* 43 U.S.C. § 1712(c) (2011); 16 U.S.C. § 1604(a), (b) (2011); 16 U.S.C. § 668dd(e)(1)(A)(iii) (2011).

[33] *E.g.*, 43 U.S.C. §1711.

[34] NATIONAL PARK SERVICE, MANAGEMENT POLICIES 2006, at 4.2, 5.2.1.

[35] National Forest Planning Rule, Purpose and Need for Rule, 77 Fed. Reg. 21162, 21164 (Apr. 9, 2012).

[36] 36 C.F.R. § 219.6(a).

[37] § 219.6(b)(3).

concern."[38] Through this front-end assessment, the Forest Service can identify wildlife habitat management concerns and, where appropriate, begin to design collaborative adaptive processes through stakeholder input. BLM's land management planning policies suggest that BLM could deploy a similar approach to implementing collaboration and adaptation.[39]

The Forest Service has two additional legal supports for collaborative and adaptive management, each of which it shares with another land management agency. Both the Forest Service and BLM must engage in interdisciplinary planning, which can drive diverse stakeholder input and increased learning in the management process.[40] Also, the Forest Service and the Fish and Wildlife Service are obligated to conserve the diversity of wildlife and plant species.[41] This mandate can provide an ecologically sound objective for collaborative and adaptive processes, one that will maximize the probability of ecosystem resilience in a changing climate.

Major federal land management actions are subject to NEPA,[42] which embraces many of the same collaborative and adaptive principles found in the general land management statues. For example, just as FLPMA requires interdisciplinary planning, NEPA requires interdisciplinary environmental

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[38] § 219.6(b)(5). The eventual plans must themselves provide for social, economic, and ecological sustainability, goals that will be difficult to achieve in a changing climate without more collaboration and adaptation. § 219.8.

[39] U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MANAGEMENT, LAND USE PLANNING HANDBOOK 2-9, 15, 32-36 (H-1601-1).

[40] 16 U.S.C. § 1604(b), (f)(3) (2011); 43 U.S.C. § 1712(c)(2) (2011).

[41] 16 U.S.C. § 668dd(a)(4)(A), (B). (N) (2011); *id.* § 1604(g)(3)(B).

[42] 42 U.S.C. § 4332(C) (2011).

assessments.[43] Moreover, NEPA provides for collaboration by mandating that action agencies "cooperat[e] with State and local governments, and other concerned public and private organizations,"[44] and consult with each federal agency that "has jurisdiction by law or special expertise with respect to any environmental impact involved."[45] The regulations implementing NEPA accordingly "emphasize agency cooperation early in the NEPA process,"[46] and require the lead agency to invite affected state, local, and federal agencies, as well Indian tribes, the proponent of the action, and other interested persons to cooperate in the NEPA process.[47] After determining which parties will participate in the NEPA analysis, the lead agency allocates responsibilities among the cooperating parties according to areas of expertise.[48] Because adaptive management is essentially a response to front-loaded environmental assessment, NEPA seems a natural home for designing and implementing iterative processes.[49]

Furthermore, before a federal land manager may authorize, fund, or carry out an action that is likely to threaten the existence of an endangered species, the land manager must consult with the Fish and Wildlife Service to ensure preservation of the species and its habitat.[50] Although not as broadly

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[43] 42 U.S.C. § 4332(2)(A) (2011).
[44] 42 U.S.C. § 4331(a) (2011).
[45] *Id.* § 4332(2).
[46] 40 C.F.R. 1501.6.
[47] 40 C.F.R. 1501.7(a)(1).
[48] 40 C.F.R. 1501.7(a)(4).
[49] THE NEPA TASK FORCE REPORT TO THE COUNCIL ON ENVIRONMENTAL QUALITY 44-48 (2004).
[50] 16 U.S.C. § 1536(a)(2) (2011).

collaborative as NEPA and most land management planning statutes, the consultation provision nonetheless helps to close jurisdictional divides by facilitating agency interaction.

When the consultation process indicates an action is likely to impact a protected species, the Fish and Wildlife Service may issue an incidental take statement or a biological opinion, depending on the severity of the likely impacts.[51] The incidental take statement may provide "reasonable and prudent measures" that are "necessary or appropriate to minimize the impacts, i.e., amount or extent, of incidental take."[52] Similarly, the biological opinion may identify "reasonable and prudent alternatives" that "would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat."[53] The reasonable and prudent measures and alternatives can both allow for implementation of adaptive and collaborative management.[54] By implementing such alternative measures, proponents of actions likely to impact protected species can obtain what amounts to a compromise between development and conservation, and perhaps create a more certain environment for pursuing the action at issue.

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[51] 16 U.S.C. § 1536(b)(4) (2011).

[52] 50 C.F.R. § 402.02; *see also* U.S. FISH & WILDLIFE SERVICE, ESA SECTION 7 CONSULTATION HANDBOOK 4-1 (1998).

[53] 50 C.F.R. § 402.02. U.S. FISH & WILDLIFE SERVICE, *supra* note 52, at 9-1.

[54] But, as Professor Doremus notes, in this context, the Service has "us[ed] the promise of adaptive management to avoid politically tough decisions." Holly Doremus, *Adaptive Management, the Endangered Species Act, and the Institutional Challenges of New Age Environmental Protection*, 41 WASHBURN L.J. 52, 72 (2001).

Accordingly, there exist multiple avenues for federal land managers to manage wildlife habitat adaptively and collaboratively. Because the federal land managers have the legal authority to engage adaptive and collaborative wildlife management in various ways, as well as compelling reasons to do so, the task is to improve upon implementation efforts to date. So far, efforts have failed mostly as a result of deficient front-end preparation and inadequate implementation. The object, then, is to ensure agencies appropriately and effectively implement collaborative and adaptive wildlife management.

Adequate and Effective Implementation

Attempts to implement adaptive and collaborative management to date have failed primarily because agencies have provided no guidance on when or how to implement adaptive or collaborative decision-making.[55] Collaboration and adaptation differ from the traditional front-end, open-hierarchical resource management agency decision-making process. A clear explanation of how agencies will collaboratively and adaptively manage wildlife in the traditional resource management world is therefore a necessary component of implementation.

Although both decision-making structures are highly contextual and accordingly cannot be completely summarized with a recipe, certain

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[55] J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L. REV. 424, 440 (2010).

considerations nonetheless apply in all cases of adaptation and collaboration. By failing to acknowledge, let alone work through, these fundamental issues, agencies have mostly failed to implement effectively adaptive and collaborative efforts. Accordingly, although agencies cannot spell out precisely how collaboration and adaptation should proceed in every instance, the basic ingredients, to date often ignored, should be required elements of implementing collaborative and adaptive management. By requiring only the minimal components known to be necessary to evaluate and implement collaborative and adaptive management, agencies will retain discretion to apply those elements in context and to continue to develop management techniques through experimentation. And while some could object to the propensity of additional planning burdens to further paralyze agencies, collaborative and adaptive management will not succeed if agencies fail to take the time up front to sufficiently assess, design, and commit to the processes to be employed.

When

Not every wildlife management problem will be a good fit for adaptive and collaborative governance. Some problems might be suitable to resolution through adaptive or collaborative decision-making, but not both. To help avoid the failures that follow from employing collaborative and adaptive management in the wrong context, wildlife managers must be required to conduct a formal, front-end analysis, subject to public participation,[56] of whether collaborative or adaptive decision-making is appropriate for an expressly stated resource management objective.[57] Such a front-end formal analysis can be subsumed within existing processes, which generally already provide for the requisite public participation.

For adaptive management, the analysis must show uncertainty relevant to management objectives, the ability of the resource manager to respond to new information, and a reasonable likelihood of improving understanding through adaptive management.[58] Likewise, before pursuing collaborative governance, a resource management agency must formally assess what parties might be interested in a stated management objective, why those parties might be interested in the objective, and how collaboration can improve the likelihood that the objective will be achieved, while also inviting additional parties to notify the agency of their particular interests in the problem.[59] As in rule making,[60] an agency must publicly notice the front-end analysis and accept public comment on it,[61] through which interested parties can challenge, support, or supplement the resource manager's analysis. Such a requirement can easily be fulfilled through existing public

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[56] HOLLY DOREMUS ET AL., MAKING GOOD USE OF ADAPTIVE MANAGEMENT 8 (Ctr. for Progressive Reform White Paper #1104, 2011).

[57] *See* DOREMUS ET AL., *supra* note 56, at 6, 8, 10.

[58] Doremus, *supra* note 13, at 1466; DOREMUS ET AL., *supra* note 56, at 10.

[59] These considerations closely track the cooperating party process under NEPA.

[60] 5 U.S.C. § 553(c).

[61] DOREMUS ET AL., *supra* note 56, at 8.

notice requirements under NEPA, ESA, and land management statutes and regulations.

How

After explaining why adaptive or collaborative decision-making is appropriate, the manager must next explain as part of the decision to implement collaborative and adaptive management how the management techniques will be implemented. That explanation must build upon the threshold decision to implement either decision-making method, though it could comprise a part of the same document setting forth the threshold decision to implement collaborative and adaptive management.

An adaptive management plan must focus on the information gap to be addressed and its relevance to management goals, and explain in detail the process through which the agency will develop new information and feed that information back into management decisions. That process must include an information gap assessment, development of testable hypotheses, action selection, implementation, monitoring, evaluation, and reassessment of management actions in light of information learned. Clear expression of the initial premise for adaptive management—the information gap—will help to ensure that the flexibility of adaptive management does not lead a resource manager to "drift"[62] too far from the objective that warranted implementing adaptive management in the first place. At the same time, clear

[62] Ruhl, *supra* note 9, at 55.

commitments to perform the continuous, successive steps of the iterative process could help to constrain "volatility"— revising decisions too substantially too soon in the process—by requiring agencies to think through and study decisions before acting. [63] With the incorporation of each of these requirements into an adaptive management plan, the agency decreases uncertainty in the process and increases the likelihood that adaptive management will yield its promised ends of increased knowledge and more effective management.

A collaborative management plan must similarly restate its threshold finding—how collaboration is intended to address a particular problem—while also explaining in detail how collaborative decision-making will proceed. The plan must name the parties that have voluntarily agreed to participate and their interests in the management objective, explain how those parties were selected, and spell out the terms for other parties to join the process. The plan must explain the decision-making structure, including the model of collaboration to be employed, which will also dictate decision participation and authority; methods for resolving conflict; and the party that will facilitate the collaborative process.

Two of the four models of collaborative decision-making—open-hierarchical and closed-flat—are suitable for wildlife management. An open-flat, or consensus, decision-making model is arguably the most democratic

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[63] Ruhl, *supra* note 9, at 55. Volatile decision-making could indicate inadequate inquiry and poor action selection and design.

approach of the four. However, it is also slow to act, and potentially unable to act on the most divisive issues. For these reasons, an open-flat model is ill-suited to addressing wildlife management challenges in a changing climate. A closed-hierarchical model, by contrast, allows resource managers to act quickly, but at the cost of decreased democratic participation, which can decrease decision durability.[64] An open-hierarchical model attempts to balance these competing concerns of democratic legitimacy and efficiency. However, as reflected in current administrative decision-making processes, an open-hierarchical model might not provide meaningful opportunities for parties other than the decision-maker to participate in the decision-making process.[65]

Whether land managers can even act outside of a hierarchical model is questionable. Under the principles of *National Parks and Conservation Association v. Stanton*,[66] federal land management agencies must retain "final reviewing authority"[67]; in collaborative terms, the agency must sit atop the hierarchy. Although *Stanton* concerned only the National Park Service and one decisional arrangement, it appears doubtful that a federal land manager could implement a flat collaborative decision-making structure

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[64] The limit to participation in a closed-hierarchical model could violate public involvement requirements in resource management planning statutes. *See, e.g.*, 43 U.S.C. § 1712(a).

[65] Charles G. Curtin, *Integrating and Applying Knowledge from Community-Based Collaboratives, in* COMMUNITY-BASED COLLABORATION: BRIDGING SOCIO-ECOLOGICAL RESEARCH AND PRACTICE 19, 38 (E. Franklin Dukes et al. eds. 2011).

[66] 554 F. Supp. 2d 7 (D.D.C. 1999).

[67] *Id.* at 20.

without running afoul of *Stanton's* limitations on delegation.[68] The challenge for federal land managers is thus to ensure that stakeholder participation in the decision-making process is provided from the outset, and not merely as an afterthought to an already arrived at decision.[69]

Collaborative and adaptive management plans are not ends in themselves, but only explanations of the means employed to achieve substantive goals (e.g., endangered species conservation). Adaptive and collaborative management plans accordingly are not substitutes for substantive management mandates.[70] For example, if BLM implements an adaptive and collaborative resource management plan, it must nonetheless demonstrate compliance with the multiple-use, sustained-yield management objective and undue degradation obligations.[71] In this regard, the baseline requirements for implementing collaborative and adaptive management act only to supplement existing agency processes and substantive standards when adaptive and collaborative management is implemented.

Accountability

Agencies must be held to account for adequately implementing collaborative and adaptive management. However, how agencies are held to account for both the design and implementation of collaborative and adaptive

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[68] *See id.*
[69] Curtin, *supra* note 65.
[70] Ruhl & Fischman, *supra* note 55.
[71] 554 F. Supp. 2d at 20.

management will be a function of the legal method through which the agency deploys collaborative and adaptive management. For example, agency implementation of collaborative and adaptive management in the NEPA process is subject to judicial review under the Administrative Procedures Act.[72] Similarly, collaboration and adaptation under the Endangered Species Act can be reviewed through citizen enforcement suits.[73]

However, collaboration and adaptation in the context of federal land management are not always easily subjected to judicial scrutiny. If agencies simply add the necessary collaborative and adaptive implementation components to existing planning processes and execute plans accordingly, those actions alone would not likely provide a judicial review mechanism to ensure that agencies adequately plan or effectively implement collaborative and adaptive management.

Ohio Forestry Association, Inc. v. Sierra Club[74] dictates that federal land management plans are generally not subject to pre-implementation judicial review.[75] Similarly, *Norton v. Southern Utah Wilderness Alliance*[76] provides that land management agency planning commitments are generally not enforceable through the Administrative Procedure Act's authority to "compel agency action unlawfully withheld."[77] In light of these cases, agency

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[72] 5 U.S.C. §§ 702, 706 (2011).
[73] 16 U.S.C. § 1540(g) (2011).
[74] 523 U.S. 726 (1998).
[75] 523 U.S. at 732.
[76] 542 U.S. 55 (2004).
[77] 542 U.S. at 69-72 (applying 5 U.S.C. § 706(1)).

omissions of key components of collaborative and adaptive processes, as well as agency failures to implement processes set forth in management plans, could be insulated from judicial review. Without judicial review, there would be little guarantee that management agencies will move beyond the shortcomings of adaptive and collaborative management to date and effectively respond to the challenges wildlife will face in a changing climate.[78]

A new statutory provision for review of management plan adequacy and implementation could break down barriers to review of planning and plan implementation, and thereby help to ensure that agencies do not continue to omit critical components of collaborative and adaptive management processes. Nonetheless, several considerations counsel against implementing collaborative and adaptive management through new legislation at this stage. First, additional statutory requirements might overly constrain experimentation in new management techniques and further paralyze agencies already bogged down with process and analysis mandates.[79] Second, the need for deployment of new management methods is immediate. Given the political gridlock in Congress, timely enactment of effective legislation is unlikely. Arguably, legislation is not even necessary because federal land management agencies already have adequate statutory

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[78] Although resource management agencies ostensibly support collaborative and adaptive methods, political pressures can sometimes overrides best management practices. Judicial review provides a counterweight to such political pressure.

[79] *See, e.g.*, U.S. FOREST SERVICE, THE PROCESS PREDICAMENT: HOW STATUTORY, REGULATORY, AND ADMINISTRATIVE FACTORS AFFECT NATIONAL FOREST MANAGEMENT 7 (2002) (explaining how existing procedural requirements frustrate achievement of agency objectives), *available at* http://www.fs.fed.us/projects/documents/Process-Predicament.pdf.

authority to manage adaptively and collaboratively. What is needed, then, is a mechanism for advancing collaborative and adaptive management that provides greater accountability than the types of planning activities at issue in *Ohio Forestry* and *Norton*, but that is also less restrictive than new statutory obligations.

Although *Norton* held that agency planning commitments are generally not enforceable, two avenues remain for enforcing management plan commitments under *Norton*. First, where agencies are required to conform their actions to management plans (e.g., BLM), actions not conforming to plans can be set aside as contrary to law under the APA.[80] Second, an agency planning commitment can be enforced where there is a "clear indication of binding commitment in the terms of the plan."[81] Accordingly, pursuant to *Norton*, agencies could ensure more effective implementation of collaborative and adaptive management by unequivocally committing to complete the steps in the collaborative and adaptive process with expressly binding language in the management plan.

However, the adequacy of the planning commitments—the incorporation of the elements necessary for effective collaborative and

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[80] 543 U.S. at 65 (citing 5 U.S.C. 706(2)). The central point of *Norton* is that although implementation actions not conforming with plans can be set aside as contrary to law, courts will not force agency to act on ambiguous planning commitments not otherwise required by law. *Id.*

[81] *Id.* at 69. The fatal deficiency of the claims in *Norton* was that the underlying planning actions were not "legally required," *id.* at 63, and therefore the agency's actions could not be considered "unlawfully withheld," § 706(1). Justice Scalia expressed some doubt, however, about whether plan commitments can be binding enough to be "legally required." *See id.* at 71 ("*perhaps* when language in the plan itself creates a commitment binding on the agency") (emphasis added).

adaptive management—could still escape review under the ripeness analysis of *Ohio Forestry*.[82] However, *Ohio Forestry* provides a subtle but important distinction between substantive and procedural planning requirements that could allow for challenges to collaborative and adaptive management plans to surmount ripeness objections. The substantive management mandates at issue in *Ohio Forestry* were results-oriented.[83] Therefore, the appropriate time for judicial review of agency action, according to the Court, was not upon agency commitment to those goals, but rather when the agency took action to implement those objectives.[84] By contrast, as Justice Breyer explained, procedural mandates, such as those set forth in NEPA, are most ripe for review at the time the process is required.[85]

Thus, agencies could be held to account for appropriate and complete collaborative and adaptive management in the land management context by incorporating implementation baselines into decision documents. The most straightforward approach to ensuring judicial review would be to incorporate baselines into NEPA analyses, though agencies could similarly set forth process commitments in planning and other decision documents. The implementation baselines should be crafted like NEPA to focus on process to avoid the ripeness barrier of *Ohio Forestry*. They also should explicitly state

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[82] As a result of the hardship of exclusion from the decision-making process, decisions set forth in a management plan about who can participate in a collaborative effort might not encounter the same ripeness barrier as the claims in *Ohio Forestry*. 523 U.S. at 733 (noting that the plan at issue did not create any hardship to the parties).

[83] 523 U.S. at 737.

[84] *Id.*

[85] *Id.*

the binding nature of planning commitments to perform the basic procedural steps of the iterative and collaborative process, thereby increasing the strength of judicial review of plan implementation.

Ideally, an agency will deploy collaborative and adaptive management through a series of steps, beginning with large-scale planning documents, like programmatic environmental impact statements or resource management plans.[86] Those big-picture decisions should set forth a binding commitment to follow express but general rules for deciding when and how to manage adaptively and collaboratively.[87] Then, through individual decisions, such as permitting or site-specific environmental assessment, the agency can work through the propriety and implementation of collaboration and adaptation in light of the general framework already established.[88]

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[86] As Professors Ruhl and Fischman observed, large-scale planning documents are more likely to successfully incorporate adaptive management because the larger scales allow more "slack" for agencies to learn and make trade-offs. Ruhl & Fischman, *supra* note 55, at 445-54. BLM encouragingly took this approach in large-scale planning for solar energy development. *See* U.S. Bureau of Land Mgmt., Approved Resource Management Plan Amendments/Record of Decision (ROD) for Solar Energy development in Six Southwestern States 19-20 (Oct. 2012) (committing to adaptive management), *available at* http://solareis.anl.gov/documents/docs/Solar_PEIS_ROD.pdf.

[87] While BLM considered adaptive management at the right time—the outset of planning—BLM nonetheless repeated the most basic error in adaptive management implementation to date by failing to explain in sufficient detail when and how BLM would manage adaptively. *See id.*

[88] Ruhl & Fischman, *supra* note 55, at 458 (arguing that site-specific NEPA assessments tied to an overarching cumulative study are well-suited to adaptive management). However, tiering can also make it easier for agencies to defer decisions on difficult issues under the guise of adaptive learning. Ruhl & Fischman, *supra* note 55, at 458-60.

Incentives

Because federal agencies play only a partial role in the patchwork of wildlife management, revising federal land management agency decision-making processes will address only a fraction of the challenges wildlife will face in a changing climate. The federal land management agencies must therefore provide not only an avenue but also encouragement for other parties to join the adaptive and collaborative process. Other federal agencies, which might control adjoining ecosystem fragments; states, which hold significant responsibility for wildlife management; and other parties with a stake in wildlife management decisions must be brought into the management framework. In this sense, federal land managers can act as a hub to unite the many separate spokes in wildlife management. And by closing the jurisdictional, ecological, and political divides through the management process, wildlife managers can more effectively ensure the realization of management objectives.

To date, lack of funding for adaptive management and incentives for collaborative governance have undermined implementation of both methods. Additional planning burdens might only provide further deterrence. Therefore, incentives are an integral component of carrying forward experimentation in collaborative and adaptive management.

Many legal scholars have advanced ideas on how to better incentivize collaboration and adaptation. Professor Camacho, for example, has argued for the creation of a collaborative learning infrastructure to help break down the information sharing barriers that attend jurisdictional fragmentation.[89] Professors Ruhl and Fischman have supported the establishment of endowments or annuities to provide long-term financial commitments to the learning process of adaptive management.[90] Legal observers, however, have paid little attention to the synergies of collaborative and adaptive principles, specifically how adaptive processes incentivize collaboration and collaboration contributes much needed resources for adaptation.

Some of the principal practical benefits of collaboration come in the form of shared resources. The different perspectives, knowledge, technical specialties, and financial resources that come with collaboration can serve the resource intensive iterative process of adaptive management. Under an ideal collaborative arrangement, which agencies should pursue in the design of collaborative frameworks, different components of the collaborative and adaptive management plan are tailored to the different contribution capacities of participants.[91] By designing the process to capitalize on

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[89] Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1, 65-68 (2009); *see also* Ruhl, *supra* note 13, at 1394 (arguing for the development of transgovernmental networks). The National Climate Change and Wildlife Science Center and Landscape Conservation Cooperatives might serve as such an infrastructure.

[90] Ruhl & Fischman, *supra* note 55, at 481-82; *see also* Melanie Hughes McDermott, Margaret Ann Moote, & Cecilia Danks, *Effective Collaboration: Overcoming External Obstacles*, *in* COMMUNITY-BASED COLLABORATION: BRIDGING SOCIO-ECOLOGICAL RESEARCH AND PRACTICE 81, 87, 97 (E. Franklin Dukes et al. eds. 2011) (noting that lack of resources hinders collaborative efforts and arguing for increased funding).

[91] Different participants will be able to contribute in different ways. Some citizen groups, such as outdoor recreationists, might be well-suited to aid in monitoring efforts, while other resource users, such as industry, might be able to offer specialized technical assistance.

collaborator capacities, the increased and diversified resources of a collaborative effort can allow for more efficient implementation of adaptive management.

At the same time, the shared resource benefit of collaboration should itself serve as an incentive for cooperation even in lieu of the increased resource needs of adaptive management. However, a lack of guidance on how agencies may collaboratively make decisions has deterred agencies from taking advantage of the benefits of collaboration. The contours of a clearly explained adaptive learning process, channeled through a collaborative decision-making framework, can define the terms for agency interaction and accordingly remove the lack-of-guidance impediment to collaboration. In this way, the decision-making structure and the adaptive plan set the terms for interagency engagement, thereby filling the gap in guidance on collaboration.

The need for incentives to pursue collaborative and adaptive management, coupled with the compatibility and reinforcing values of collaborative and adaptive processes,[92] raises the question of whether agencies implementing one method should be required to implement the other. Scholars from outside the legal discipline have noted that both collaboration and adaptation share similar philosophical underpinnings. As one observer noted, "The need for adaptive management is grounded in the recognition that people do not know enough to manage ecosystems with

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[92] *See* discussion *supra* at 97-100 and accompanying footnotes.

predictable results,"[93] while "[t]he need for collaboration is grounded in the recognition that no single entity can know enough to manage a particular place with predictable results."[94] In other words, multiple sources of knowledge are necessary for effective adaptive management, and collaboration is the mechanism for bringing that diversity of perspectives to bear on the adaptive management process.[95]

Like adaptation, collaboration will be a critical element to resolving many wildlife management challenges in a changing climate. However, again like adaptive management, collaboration might not be a worthwhile commitment of resources in every case. For example, some problems might be free from political conflict and confined to a particular jurisdiction, in which case there would be no fragmentation for collaboration to address.[96] Also, in some of the most politically contentious wildlife issues—such as endangered large predators—state law and federal law can expressly conflict.[97] Those conflicts can make collaboration toward a shared goal challenging, if not impossible. In the case of less explicit conflicts among stakeholders, such as

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[93] Dukes, *supra* note 86, at 199.

[94] Dukes, *supra* note 86, at 199; *see also* Fernandez-Gimenez & Ballard, *supra* note 72, at 47-48, 56 (arguing that collaboration is necessary for effective adaptive management).

[95] Curtin, *supra* note 65, at 40 ("it is hard to envision an effective adaptive process that does not rest on a synthesis of different knowledge types and a healthy does of humility on all sides.").

[96] If any such cases exist, they will more than likely constitute a small fraction of wildlife management problems.

[97] As Professor Coggins observed, "Senator Hatch and the Southern Utah Wilderness Alliance will never agree on the appropriate extent of official wilderness," nor will Montana ranchers and Defenders of Wildlife ever "reach common answers to such questions as whether wolves should be reintroduced to Yellowstone or whether bison migrating out of Yellowstone should be shot." Coggins, *supra* note 93, at 166.

competing mandates between use and preservation, or among particular types of uses, collaboration might be the optimal solution.

Thus, although collaboration and adaptation are not only highly compatible, but also often complimentary, the implementation of one management technique should not require the other.[98] To mandate otherwise could force managers pointlessly to expend resources, thereby undermining support for innovative management techniques and depriving managers of appropriate tools. Still, agencies should recognize the propensity for collaborative and adaptive efforts to support one another and accordingly incentivize pursuit of both methods.

In recognition of the synergistic benefits of collaborative and adaptive methods, agencies should require as part of the front-end analysis of implementing collaborative or adaptive management an explanation of why the agency is or is not implementing one of the management methods in combination with the other. This component of the threshold planning criteria will encourage resource managers to look seriously at the benefits and challenges of implementing collaboration and adaptation independently and together. Those decisions, in turn, will help to further understanding of the relationship between collaborative and adaptive decision-making processes.

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[98] *But see* Rebecca J. McLain & Robert G. Lee, *Adaptive Management: Promises and Pitfalls*, 20 ENVTL. MGMT. 437 (1996) (arguing that collaboration is necessary for effective adaptation).

Implementation Opportunities

Vast quantities of oil shale and tar sands lie beneath large swaths of BLM land in the Green River, Washakie, Uinta, and Piceance basins scattered around the borders of Colorado, Wyoming, and Utah. Home to numerous species of birds and mammals, including a long list of protected species,[99] as well as trophy game animals,[100] the lands overlying the shales and sands are slated for development.[101] The aridity of the region, located in the upper reaches of the heavily regulated Colorado River system,[102] already presents one of the greatest challenges to oil shale and tar sands mining because predominant techniques for extracting and processing both fuels requires substantial quantities of water.[103] To complicate matters, as a result of climate change the region is likely to become more arid, experiencing reduced snow packs, decreased spring and summer precipitation, and changes in runoff periods.[104]

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[99] U.S. Bureau of Land Management, Draft Oil Shale and Tar Sands Programmatic EIS, at 3-166 (Jan. 27, 2012), http://ostseis.anl.gov/documents/peis2012/index.cfm [hereinafter OSTS Draft PEIS]

[100] Western Resource Advocates, Oil Shale Development and Wildlife, http://www.wradv.info/land/oswild.php (last visited Feb. 15, 2013) (comparing maps of elk and mule deer habitat with development area).

[101] *See id.*; *see also* J.R. Dyni, *Geology and Resources of Some World Oil-Shale Deposits*, 20 OIL SHALE 193, 231 (2003) (discussing historical development interest in Mountain West shale).

[102] *See, e.g.*, LAWRENCE J. MACDONNELL ET AL., WATER ON THE ROCKS: OIL SHALE WATER RIGHTS IN COLORADO 35-38 (W. Resource Advocates 2009) (discussing ways Colorado River regulation will impact shale development).

[103] U.S. Dep't of the Interior, Bureau of Land Management, 2012 Oil Shale & Tar Sands Programmatic EIS Information Center, About Tar Sands, http://ostseis.anl.gov/guide/tarsands/index.cfm (last visited Feb. 15, 2013)

[104] *See* Tim P. Barnett et al., *Human-Induced Changes in the Hydrology of the Western United States*, 319 SCIENCE 1080 (2008); U.S. Fish & Wildlife Svc., Utah: Managing

These conditions will challenge the survival of wildlife facing the stresses of extractive industry, as well as the ability of industry to mine the resources in the first place. The development of oil shale and tar sand resources in wildlife habitat thus provides a useful example that, when analyzed in light of past agency efforts to manage resources collaboratively and adaptively, shows how collaborative and adaptive wildlife management can be more appropriately deployed to cope with changing climate conditions. It also shows the many ways that opportunities to implement alternative wildlife management techniques arise.

Federal land managers should use large-scale decisions, such as management plans or programmatic environmental reviews, to establish the general rules of collaboration and adaptation. The long-term uncertainty of climate change makes difficult defining the particulars of many as of yet unforeseen wildlife management problems. Uncertain and at times volatile market conditions for natural resources, the extraction of which often impacts wildlife, further complicates long-term wildlife management actions. Through large-scale decisions establishing basic rules for implementation, land managers can build the framework within which managers can respond to particular wildlife problems as they arise.

Water Resources for Fish, Wildlife and People (June 6, 2011) (discussing climate change impacts on wildlife in Upper Colorado River Basin), http://www.fws.gov/news/blog/index.cfm/2011/6/6/Utah-Managing-Water-Resources-for-Fish-Wildlife-and-People; *see also* UNION OF CONCERNED SCIENTISTS, CLIMATE CHANGE IN THE UNITED STATES: THE PROHIBITIVE COSTS OF ACTION 3 (Aug. 2009)

Thus, where oil shale development will require resource management plan revisions, BLM should incorporate into revised plans binding commitments to implement adaptation and collaboration according to express implementation baselines. Those baselines will establish the general rules for when and how to implement collaborative and adaptive management, setting forth the processes that must be followed in particular collaborative and adaptive projects implemented pursuant to the management plan.[105]

When proposed uses—such as oil shale extraction—are consistent with existing resource management plans, BLM would likely be reluctant to revise plans earlier than necessary, given the effort required. In the meantime, the agency can still establish baseline rules for collaboration and adaptation through either leasing decisions or the NEPA process. In the case of the oil shale development in the Mountain West, BLM is working to complete a programmatic environmental impact statement to provide a systematic approach to developing oil shale and tar sands.[106] Through the NEPA process, BLM coordinated and consulted with numerous federal, state, and local government entities.[107]

Although the interface of oil shale development—an evolving, experimental technology—with wildlife management could present a prime

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[105] BLM's track record for incorporating adaptive management into large-scale plans has not been spectacular. *See, e.g.*, U.S. BUREAU OF LAND MANAGEMENT, ELY DISTRICT APPROVED RESOURCE MANAGEMENT PLAN 20 (Aug. 2008) (failing entirely to explain how adaptive management will be implemented).

[106] OSTS Draft PEIS, *supra* note 99.

[107] OSTS Draft PEIS, *supra* note 99, at 7-5 to 7-6.

opportunity for adaptive and collaborative management, BLM did not refer to either collaboration or adaptation in the draft PEIS.[108] This is particular troubling because the infancy of the technology allows room for regulatory pressures to mold the process. For example, the water-intensiveness of oil shale and tar sands development could be mitigated by the evolution of technologies that use less water.[109] BLM could have used collaborative processes to encourage development of such technologies to mitigate wildlife impacts, and adaptive learning to gauge the successes of such technological innovations in achieving the desired end.

The large-scale NEPA assessment could have provided a second opportunity, in lieu of management plan revision, for BLM to set forth broadly applicable collaborative and adaptive implementation baselines. As development proceeds on individual tracts, BLM district offices could assess the propriety in each case of utilizing either management technique according to the methods prescribed in the resource management plan or NEPA analysis.

For example, where a particular leasing proposal potentially jeopardized a protected species, BLM and other interested parties, including but not limited to the Fish and Wildlife Service and leasing applicant, could

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[108] BLM's neglect of adaptation and collaboration may be due in part to the recent failures of similar efforts on the nearby Pinedale Anticline. *See infra* at 138-39 and accompanying notes.

[109] One company claims to have developed a citrus-based solvent to process tar sands the will reduce dependence on water. *See* Jeremy Miller, *Will Utah's Tar Sands Make It the Alberta of the High Desert?*, High Country News, July 23, 2012, http://www.hcn.org/issues/44.12/will-utahs-tar-sands-make-it-the-alberta-of-the-high-desert.

assess whether and how to collaboratively and adaptively manage issues arising from the proposed development. Both decisions—whether and how to collaborate and adapt—must conform to the general rules set forth in the large-scale plan or environmental impact statement, which require, among other things, a reasoned analysis of the propriety of managing adaptively and collaboratively for the problem at hand. Those decisions could be incorporated into the individual leasing decision documents—such as the site-specific NEPA analysis or leasing record of decision.

BLM took essentially this approach to oil and gas development on the Pinedale Anticline in Wyoming.[110] On paper, BLM's plans for adaptive and collaborative management of the Pinedale Anticline were relatively sufficient. BLM adopted "A Framework for Adaptive Environmental Management for Exploration and Development on the Pinedale Anticline" that essentially incorporated each of the necessary steps in the adaptive management process.[111] The framework set forth stakeholder participation in decision-making as a central objective, identified potential collaborators,

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[110] U.S. BUREAU OF LAND MANAGEMENT, FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE PINEDALE ANTICLINE OIL AND GAS DEVELOPMENT PROJECT SUBLETTE COUNTY, WYOMING 2-3 to -4 (May 2000), *available at* http://www.blm.gov/pgdata/etc/medialib/blm/wy/information/NEPA/pfodocs/anticline.Par.5357.File.dat/022cover.pdf;

[111] U.S. BUREAU OF LAND MANAGEMENT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE PINEDALE ANTICLINE OIL AND GAS EXPLORATION AND DEVELOPMENT PROJECT SUBLETTE COUNTY, WYOMING, Appx. F (Nov. 1999), *available at* http://www.blm.gov/pgdata/etc/medialib/blm/wy/information/NEPA/pfodocs/anticline.Par.6689.File.dat/053app-f.pdf [hereinafter "Draft PAOG EIS"].

named a project facilitator, and set forth a process, beginning with a stakeholder meeting, to begin collaborative and adaptive management.[112]

Nonetheless, the Pinedale adaptive management project has ostensibly failed,[113] though not as a result of inadequate process explanation. In designing the management approach, BLM focused entirely on the "how" of adaptation and collaboration, and critically failed to consider when and why to manage collaboratively and adaptively.[114] In the end, BLM's overriding commitment to maximizing development of oil and gas resources impeded the ability of adaptive management to respond meaningfully to impacts to wildlife.[115] BLM thus applied adaptive and collaborative management tools to problems they could not solve. BLM's overriding commitment to development limited BLM's ability to respond meaningfully to the information management processes yielded. This is not to say that collaboration and adaptation had no place on the Anticline; only that BLM failed to identify the problem to which collaborative and adaptive solutions could be applied.

Perhaps BLM excluded collaboration and adaptation from the draft oil shale PEIS viewed the failures in Pinedale as indications of the potential for

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[112] *Id.* at F-2 to F-9.

[113] *See* Sara Gilman, *Citizen Oversight Fizzles in Wyoming Gas Patch*, High Country News: GOAT Blog, Nov. 6, 2012, http://www.hcn.org/hcn/blogs/goat/citizen-oversight-fizzles-in-wyoming-gas-patch (noting that the Pinedale adaptive management working group voted at its October 2012 meeting to cease operations and allow its charter to expire).

[114] *See* Draft PAOG EIS, *supra* note 111.

[115] *See, e.g.*, Emilene Ostlind, *BLM Stays Course in Wyoming Gas Patch Despite Mule Deer Decline*, HIGH COUNTRY NEWS, March 21, 2011, http://www.hcn.org/issues/43.5/blm-stays-course-in-wyoming-gaspatch-despite-mule-deer-decline.

similar disappointment in the oil shale context. The appropriate response to the Pinedale story, however, is not to ignore collaboration and adaptation, but instead to expressly acknowledge that in some cases, neither method will be appropriate. It is difficult to imagine that collaboration and adaptation will not be appropriate for any wildlife management challenges that flow from the development of oil shale resources. The technology for extracting oil shale and tar sands is relatively novel, and the proposed development area interfaces not only with the habitat of protected species, but also of trophy hunting species valuable to states and local economies. By requiring assessment of whether adaptation and collaboration can effectively address particular wildlife management problems as they arise in the development of oil shale, BLM could have helped to increase understanding of the limits to collaborative and adaptive management.

VII. CONCLUSION

> *The wild creatures of the wilderness add to it by their presence a charm which it can acquire in no other way.*
>
> –Theodore Roosevelt.[1]

No longer can we expect wildlife in the future to be like wildlife in the past. At a minimum, changing climate conditions will rearrange the natural realms that wild creatures inhabit. Whether and how animals will cope with those changes remains to be seen. To the extent that wildlife cannot survive changing conditions, climate variation threatens to accelerate the current trend in the loss of U.S. wildlife. In this way, climate change may be the catalyst for the sixth great extinction of life on Earth.

Even if climate change does not contribute to the continued loss of species, the evolution of wildlife and ecosystems in response to changing climate conditions will challenge the traditional front-end, top-down approach to managing wildlife. The uncertainty of change will render futile front-loaded planning processes that depend for their validity on predictive capacity. Even in relatively stable natural systems, our ability to predict

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[1] *Wilderness Reserves*, *in* AMERICAN BIG GAME IN ITS HAUNTS 23, 24 (Boone & Crockett Club 1904).

future conditions is inadequate. However, in a complex, evolving, dynamic ecosystem rife with feedback loops and nonlinear change, resource managers' capacity to predict future conditions nears zero. As a result, managers will be hard pressed to meet substantive management mandates for sustained yield and preservation.

Wildlife managers therefore need to supplement their toolkits. Collaborative and adaptive management methods provide the right solutions to the problems managers face. By unshackling management from the traditional front-loaded process, managers can move beyond the crippling deficit climate change will bring to predictive capacities, and focus instead on resolving uncertainty through shared learning. Integrating the fragmented entities responsible for managing wildlife and habitat into shared decision-making structures will provide managers with a realistic chance of addressing the transboundary problems symptomatic of climate change, while at the same time increasing the pool of financial and human resources aimed at each problem.

As practice has shown, effectively implementing collaborative and adaptive methods is not always a straightforward proposition. The threshold question of the propriety of implementing either management method in a particular context often has not been addressed. The consequence has been the use of adaptive and collaborative management in situations where the likelihood of successful implementation is remote. Even in cases appropriate for collaborative and adaptive methods of management, agencies have, perhaps due to resource and political constraints, mostly ignored the rigor required in the iterative process of adaptive management and the definition necessary in collaborative decision structures.

The failures to practice successfully collaborative and adaptive management should not discourage the use of these techniques. Instead, the implementation shortcomings shine a light on the path to improving the use of collaborative and adaptive management. Federal land management agencies should take advantage of their special capacity to act as the hub for deploying collaborative and adaptive wildlife management. Through large-scale planning and assessment processes, federal land managers can provide clear guidance on when and how to manage wildlife collaboratively and adaptively. Land managers must require not only reasoned front-end analysis of why adaptive and collaborative management should be implemented, but also of how the resource manager intends to implement those methods. Those implementation plans must include basic criteria that ensure the implementing agency will follow through on commitments to carry out the details necessary in collaborative and adaptive processes.

Wildlife management is particularly well-suited to collaborative and adaptive management. Uncertainty and fragmentation—the symptoms collaboration and adaptation are intended to treat—dominate the field of wildlife management. Perhaps no other field of resource management suffers so acutely from fragmentation and uncertainty. The suitability of wildlife management for collaborative and adaptive techniques also will help to advance the experimentation needed to further develop knowledge of collaboration and adaptation in practice. By advancing the institutions of collaborative and adaptive management in a context well-suited to the methods, the potential for learning about when and how to implement alternative governance institutions will grow.

Choices made today will determine human relations with the inhabitants of the natural world for generations to come. Wildlife habitat managers can take the difficult steps necessary to move outside the comfortable zone of front-loaded, top-down management and make an effort to shepherd wild creatures into the new climate human actions are unleashing. Doing so will require not only brave agency action, but also the cooperation of courts and stakeholders. Or agencies can continue business as usual, and erase the progress of the last one hundred years, which saw the restoration of previously depleted wildlife populations. The impoverished natural world likely to follow such a choice cannot be what we leave for future generations.