CLIMATE CHANGE AND THE DECLINE OF THE FEDERAL RANGE: IS ADAPTIVE MANAGEMENT THE SOLUTION?

By Hillary M. Hoffmann[*]

INTRODUCTION

Livestock grazing impacts over 160 million acres of federal public lands under Bureau of Land Management ("BLM") management and ninety-five million acres of National Forest lands.[1] It is widely

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1. Felicity Barringer, *The Impact of Grazing? Don't Ask*, N.Y. TIMES (December 1, 2011, 2:05 PM), http://green.blogs.nytimes.com/2011/12/01/the-impact-of-grazing-dont-ask/?_r=1&pagewanted=print; W. Watersheds Project v. Kraayenbrink, 632 F.3d 472, 476 (9th Cir.

acknowledged as the single most extractive use of all federal public lands.[2] Despite the destructive history of grazing on federal lands, as reflected in decades of remedial legislation,[3] scholarly criticism,[4] and extensive litigation,[5] the legal structure governing livestock grazing has remained essentially unchanged for over eighty years.[6] In essence, this structure allows as many cows, sheep, and horses to graze the public range as when range conditions and forage yields were at their greatest, despite evidence of increasing temperatures across the most arid regions of the United States and climate change data predicting the overall water supply in the western United States has begun to decline and will continue to do so for the foreseeable future.[7]

In the face of scholarly urging, neither Congress nor the administrative agencies charged with managing the federal range resource have adopted any statutory or regulatory responses to the climate change data.[8] Neither new legislation nor new regulation appears likely in the foreseeable future. For these reasons, adaptive management may be the only solution already built into the agencies' decision-making framework that will allow the flexibility in range management decisions that climate change data require.

Adaptive management allows federal agencies, and individual land managers within those agencies, much-needed flexibility to make quick decisions when circumstances demand, based on a scientific method involving hypotheses, monitoring, and outcomes assessments.[9] Moreover, where the traditional model of resource management centered on discrete natural resource topics—effectively organizing the natural environment into disconnected parts, such as air, trees, water, and wildlife—adaptive management, in theory, allows land managers to make decisions for an entire ecological system, as conditions warrant.[10]

2010); FOREST SERV. RANGE MGMT., U.S. DEP'T OF AGRIC., GRAZING STATISTICAL SUMMARY 2009 at iii (2011).

2. John D. Leshy & Molly McUsic, *Where's the Beef? Facilitating Voluntary Retirement of Federal Lands from Livestock Grazing*, 17 N.Y.U. ENVTL. L.J. 1, 1 (2008).

3. 42 U.S.C. § 1901(a)(1) (2006).

4. Debra L. Donahue, *Western Grazing: The Capture of Grass, Ground, and Government*, 35 ENVT'L L. 721, 724 (2005).

5. *E.g.* Pub. Lands Council v. Babbitt, 529 U.S. 728, 734 (2000) [hereinafter *PLC*].

6. 43 U.S.C. § 315(b) (2006).

7. Brad Udall, Presentation at the Sixteenth Institute for Natural Resources Law Teachers (May 31, 2013) [hereinafter Udall Presentation].

8. Marya Torrez, *Cows, Congress, and Climate Change: Authority and Responsibility for Federal Agencies to End Grazing on Public Lands*, 14 VT. J. ENVT'L L. 1, 16 (2012).

9. J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L. REV. 424, 428 (2010); Nell Green Nylen, *To Achieve Biodiversity Goals, the New Forest Planning Rule Needs Effective Mandates for Best Available Science and Adaptive Management*, 38 ECOL. L.Q. 241, 273 (2011).

10. Ruhl & Fischman, *supra* note 9, at 428.

The primary statutes governing livestock grazing on federal lands use past behavior and use patterns to gauge permissible future uses.[11] In an attempt to modernize this ineffective legal structure, the Forest Service and BLM have taken incremental steps toward using adaptive management to make some management decisions; however, they have largely failed to realize the potential of this management model, particularly in light of climate change data.[12] Given the climate change predictions and the changed environmental circumstances that federal range managers will inevitably face[13]—such as forage loss and prolonged droughts—changes in management approaches are inevitable. This is particularly true in the context of livestock grazing, which, as mentioned above, has retrospective statutory mechanisms for determining not only permissible, but required future use.[14] Currently, the relevant statutes and regulations require the Forest Service and BLM to continually renew grazing permit applications if the permittee has complied with the terms of the previous permits, despite new information regarding water scarcity or forage depletion on the allotment in question

The Forest Service and BLM have missed the opportunity to use adaptive management as a means to avoid legal challenges under statutes such as the National Environmental Policy Act (NEPA) related to livestock grazing permit renewals on Forest Service lands, to manage the range resource in line with climate change predictions, and allow the flexibility in decision making regarding livestock grazing that climate change predictions require.[15] Part I of this article discusses adaptive management in theory and practice; explaining the various models scientists and policy makers use to incorporate adaptive management into natural resource planning decisions, providing examples of how some federal agencies have used adaptive management over the past decade to varying degrees of success. Part II explains the statutory and regulatory structure governing livestock grazing on federal lands managed by the Forest Service and the BLM, as well as the individual management decisions regarding permitting and annual operating instructions. Part III discusses climate change, on a global and

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11. *E.g.*, 43 U.S.C. § 315(b).

12. *See, e.g.*, W. Watersheds Project v. Leaverton, No. 09-cv-01604-REB-BNB, 2011 D. Col. WL 2415546, at 3–4 (D. Colo. 2011).

13. Carolyn Brickey et al., *How to Take Climate Change Into Account: A Guidance Document for Judges Adjudicating Water Disputes*, 40 ENVT'L L. REP. NEWS & ANALYSIS 11215, 11215 (2010).

14. *See generally* Hillary M. Hoffmann, *A Changing of the Cattle Guard: BLM's New Approach to Grazing Qualifications*, 24 J. ENVTL. L. & LITIG. 243, 245 (2009) (discussing the history and laws surrounding livestock grazing).

15. 42 U.S.C. § 4321 (2006).

national level, and explores the specific predictions regarding climate change's effect on the federal range. Part IV explores the potential for adaptive management to allow agencies to manage for a changed climate as it relates to livestock grazing. This article concludes that the Forest Service and BLM must incorporate adaptive management into current grazing management decision-making processes to accommodate the certainty that climate change will impact the federal rangeland.

I. ADAPTIVE MANAGEMENT: THEORY AND PRACTICE

A. The Birth of Adaptive Management Theory: A New Approach to Understanding and Managing Ecosystems

The concept of adaptive management originated in the late 1970s, first appearing in a book by ecologist C. S. "Buzz" Holling, entitled *Adaptive Environmental Assessment and Management*.[16] Holling's central premise was that the statutory regime governing natural resource management and use was flawed because of its "divide and regulate" structure—parts of an ecosystem were broken out and regulated independently, sometimes by different agencies under separate statutes and regulatory regimes.[17] While "divide and regulate" made sense to Congress in theory, and organized natural resources well on paper; in practice, it forced resource managers to make decisions impacting entire ecosystems in a piecemeal fashion, without considering the greater impacts of those decisions on the entire regional ecosystem and at times, in spite of them.[18]

This structure also belied the scientific approach to resource planning, making it difficult for resource managers to implement measures recommended by the scientific community in a comprehensive way.[19] Under NEPA, for example, agencies determined whether to allow major federal actions in certain areas based on the discrete impacts of those decisions on one sector of the ecosystem and on how the development would violate resource-specific standards.[20] Likewise, under the traditional management model, a BLM official considering whether to close a grazing

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16. C.S. HOLLING ET AL., ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT ix (C.S. Holling ed., 1978); Kai N. Lee & Jody Lawrence, *Restoration Under the Northwest Power Act: Adaptive Management: Learning From the Columbia River Basin Fish and Wildlife Program*, 16 Envtl. L. 431, 442 n.45 (1986) (tracing the term "adaptive management" to Holling's Book).

17. Emily Gardner, *Adaptive Management in the Face of Climate Change and Endangered Species Protection*, 40 ECOL. L.Q. 229, 234 (2013).

18. *Id.*

19. *Id.*

20. National Environmental Policy Act of 1969, 42 U.S.C. § 4332 (2006).

allotment as part of a revision to a Resource Management Plan might consider erosion impacts, which is what the statutes require,[21] but not the impact that closing the allotment would have on the overall water supply in the watershed. This approach misses the proverbial forest for the trees, given that erosion and other impacts noted in the statutes are often a symptom of changes in the water table, and possibly, of changes in the global climate. The water table, in turn, is a vital component of any ecosystem; thus, making decisions using erosion as a barometer misses the critical importance of the available water resource.[22]

In the 1970s, Holling argued that ecosystems' dynamic tendencies require resource planners to use a more holistic, interdisciplinary approach to natural resource management.[23] Ideally, the process would constitute an informed "feedback loop," wherein resource managers would make decisions, understanding that the information upon which they based those decisions was incomplete. They would then implement the decisions and measure their results through ecosystem-wide assessments, and determine whether changes were required to meet conservation mandates in the relevant statutes and regulations.[24] The process would then begin again, and continue to accommodate both discrete and global resource allocation challenges as they arose, *ad infinitum*. This "feedback loop" would operate within a margin of uncertainty, but Holling and others posited that the incomplete information is not necessary to make sound resource management decisions.[25] All that is required, in theory, is a certain comfort level with an iterative process and the capability to quickly respond to changes in circumstance.[26]

When fully implemented, adaptive management would incorporate testable hypotheses, measure their validity, and incorporate the results on both a small discrete scale and within a larger ecosystem.[27] From its birth in Holling's book, the theory of adaptive management and its myriad forms of implementation, have received extensive support from the scientific and legal academies, as well as from the administrative agency officials tasked with implementing statutory mandates.[28] It is the implementation of this

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21. Taylor Grazing Act, 43 U.S.C. § 315(a) (2006).
22. Udall Presentation, *supra* note 7.
23. HOLLING ET AL., *supra* note 16, at x.
24. Jamison E. Colburn, *The Indignity of Federal Wildlife Habitat Law*, 57 ALA. L. REV. 417, 493 (2005).
25. Gardner, *supra* note 17 at 234.
26. *Id.*
27. Ruhl & Fischman, *supra* note 9, at 429.
28. *See* Ronald D. Brunner & Tim W. Clark, *A Practice-based Approach to Ecosystem Management*, 11 CONSERVATION BIOLOGY 48, 56 (1997); Anne E. Heissenbuttel, *Ecosystem Management-Principles for Practical Application*, 6 ECOLOGICAL APPLICATIONS 730, 732 (1996); Paul

theory that causes most of the disagreement over its value as a resource management technique.

B. Adaptive Management in Practice: A Story of Mixed Results

When implemented, adaptive management may take any of several forms, and it may encompass different components depending on the discipline in which it is used.[29] Various federal agencies have adopted formal definitions of adaptive management in their regulatory schemes. The Department of the Interior, for example, has defined it as "a systematic approach for improving resource management by learning from management outcomes."[30] This approach "involves exploring alternative ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions."[31]

The United States Fish and Wildlife Service ("FWS") defines "adaptive management" for the purposes of endangered species management as:

> an integrated method for addressing uncertainty in natural resource management. It also refers to a structured process for learning by doing . . . . Passive adaptation is where information obtained is used to determine a single best course of action. Active adaptation is developing and testing a range of alternative strategies. The Services believe that both of these types of adaptive management are appropriate to consider when developing a strategy to address uncertainty. Therefore, we are defining adaptive management broadly as a method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future

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L. Ringold et al., *Adaptive Monitoring Design for Ecosystem Management*, 6 ECOLOGICAL APPLICATIONS 745, 745–46 (1996) (Indeed, the Ecological Society of America's comprehensive study of ecosystem management treats the use of adaptive management methods as a given).

29. Julie Thrower, *Adaptive Management and NEPA: How a Nonequilibrium View of Ecosystems Mandates Flexible Regulation*, 33 ECOL. L.Q. 871, 884 (2006).

30. BYRON K. WILLIAMS ET AL., U.S. DEP'T OF THE INTERIOR, *ADAPTIVE MANAGEMENT: THE U.S. DEPARTMENT OF THE INTERIOR TECHNICAL GUIDE* 1 (2009), *available at* http://www.doi.gov/initiatives/AdaptiveManagement/TechGuide.pdf [hereinafter TECHNICAL GUIDE].

31. *Id.*

> conservation management actions according to what is learned.[32]

In turn, the United States Army Corps of Engineers defines it in the context of project mitigation as:

> the development of a management strategy that anticipates likely challenges associated with compensatory mitigation projects and provides for the implementation of actions to address those challenges, as well as unforeseen changes to those projects. It requires consideration of the risk, uncertainty, and dynamic nature of compensatory mitigation projects and guides modification of those projects to optimize performance. It includes the selection of appropriate measures that will ensure that the aquatic resource functions are provided and involves analysis of monitoring results to identify potential problems of a compensatory mitigation project and the identification and implementation of measures to rectify those problems.[33]

Finally, the Forest Service included the following definition of adaptive management in its 2008 Forest Planning Rule:

> Adaptive management: A system of management practices based on clearly identified outcomes and monitoring to determine if management actions are meeting desired outcomes; and, if not, to facilitate management changes that will best ensure that outcomes are met or re-evaluated. Adaptive management stems from the recognition that knowledge about natural resource systems is sometimes uncertain.[34]

The scientific definition is somewhat similar to the regulatory definitions above. According to the National Research Council, adaptive management "promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other

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32. Notice of Availability of a Final Addendum to the Handbook for Habitat Conservation Planning and Incidental Take Permitting Process, 65 Fed. Reg. 35,242, 35,252 (June 1, 2000).

33. 33 C.F.R. § 332.2 (2008).

34. 36 C.F.R. § 219.16 (2008).

events become better understood."[35] Subsequently, "[c]areful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process."[36] Moreover, "[a]daptive management . . . recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing."[37] In the scientific context, "[a]daptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits."[38] In theory, "its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions" among interested parties.[39]

There are three general forms of adaptive management: evolutionary, passive, and active.[40] Evolutionary adaptive management is a formal version of the "trial by error" approach, wherein scientists make decisions based on the available knowledge, gather information from "random" experiments, and make future decisions based on that randomly collected evidence.[41] As with the other forms of adaptive management, the theory underlying the evolutionary approach is that "future decisions evolve in response to past performance," but past performance is extrapolated from a randomly chosen data set.[42]

The second form—passive adaptive management—is the most common form of resource management.[43] One significant example is the Environmental Impact Statement (EIS) process under NEPA.[44] Under this approach, land managers use the "best-known practice" as of the point when they make resource management decisions. Land managers do so by using the "historical data then available" to predict future outcomes.[45] This approach assumes that both the historical data are accurate and the best-known practice is the sole option. In addition, both evolutionary and passive adaptive management methods assume that ecosystems are fairly static.[46]

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35. Courtney Schultz & Martin Nie, *Decision-making Triggers, Adaptive Management, and Natural Resources Law and Planning*, 52 NAT. RES. J. 443, 446 (2012).
36. *Id.*
37. *Id.*
38. *Id.* at 446–47.
39. *Id.* at 447.
40. TECHNICAL GUIDE, *supra* note 30, at 59.
41. *Id.* at 2.
42. *Id.*
43. Schultz, *supra* note 35, at 449.
44. TECHNICAL GUIDE, *supra* note 31, at 46.
45. *See generally id.* (explaining how land managers use adaptive management).
46. Thrower, *supra* note 29, at 874.

The third approach, active adaptive management, involves a more complex process at the outset, whereby decision-makers develop hypotheses based on the assumption that ecosystems are ever-changing, complex entities.[47] Then, they test the hypotheses through the land management decisions and subsequent monitoring. Because this method requires discrete, incremental decisions, it allows agencies and land managers to make more precise adjustments in management techniques as they gather data from the monitoring and testing.[48] The active adaptive management model assumes that ecosystems are constantly evolving, that ecosystem evolution is an inherent quality, and that resource management decisions must be made more frequently than under the passive or evolutionary approaches to account for this change.[49]

Regardless of the approach taken, adaptive management is an inherently complex decision-making process involving multiple steps.[50] First, a team of managers and scientists must "predict the outcomes of potential management alternatives."[51] Then, they "implement a management action based on the predictions;" assess the results of the action over time; and finally, "reevaluate and adjust future management actions to take these results into account."[52] Some agencies have expanded the process into sub-steps, fleshing out each of the above processes more fully.[53] Incorporation of adaptive management practices is therefore time-consuming, resource consumptive, and depends heavily on the willingness of agency decision-makers to implement it completely.[54]

If done completely, adaptive management has unlimited potential as an effective management strategy; even if resource managers err in their hypotheses or execution, they can rectify those errors as testing reveals their flaws. If done only partially, or poorly, adaptive management as a strategy can be "dangerously dysfunctional," voraciously consuming agency resources and bringing entire planning processes to a standstill.[55] Adaptive management can also be used as an administrative "excuse" for excessive delays in decision-making and implementation.[56]

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47. *Id.* at 885.
48. *Id.*
49. *Id.* at 885–86.
50. Nylen, *supra* note 9, at 274.
51. *Id.*
52. *Id.*
53. Ruhl & Fischman, *supra* note 9, at 430.
54. *Id.* at 441–42.
55. Nylen, *supra* note 9, at 275; *See also* Joseph M. Feller, *Collaborative Management of Glen Canyon Dam: The Elevation of Social Engineering over Law*, 8 NEV. L.J. 896, 933 (2008).
56. Feller, *supra* note 55, at 932.

Moreover, as the Department of the Interior has recognized, "[a]daptive management as described . . . is infrequently implemented, even though many resource planning documents call for it and numerous resource mangers refer to it."[57] Perhaps this is reflected by a lack of understanding of how to fully implement the theory—"[i]t is thought by many that merely by monitoring activities and occasionally changing them, one is doing adaptive management. Contrary to this commonly held belief, adaptive management is much more than simply tracking and changing management direction in the face of failed policies, and, in fact, such a tactic could actually be maladaptive."[58]

In short, if management objectives "are not clear and measurable, the adaptive framework is undermined."[59] There are two specific reasons for making them clear: "first, so progress toward their achievement can be assessed; second, so performance that deviates from objectives may trigger a change in management direction."[60] Second, "[e]xplicit articulation of measurable objectives helps to separate adaptive management from trial and error, because the exploration of management options over time is directed and justified by the use of objectives."[61] Without clear objectives, dedicated monitoring, and outcomes assessments, resource management is merely "management," as opposed to "adaptive management."

C. Adaptive Management Successes and Failures

Federal agencies have incorporated adaptive management techniques successfully in some contexts, and poorly in others. The National Park Service and the United States Forest Service have used adaptive management to manage the bison population in the Yellowstone area in a manner that protects their health and promotes the wellbeing of the bison and nearby livestock populations.[62] Historically, and particularly "at the end of the 19th Century, following years of hunting and illegal poaching in Yellowstone Park, the mountain bison (*Bison bison athabascae*) herd dwindled down to just twenty-three bison by actual count in 1902."[63] To save the herd, the National Park Service imported a small number of bison from two captive herds in Texas and Montana and bred them with the

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57. Schultz, *supra* note 35, at 447.
58. *Id.* at 447–48.
59. *Id.* at 449.
60. *Id.*
61. *Id.*
62. W. Watersheds Project v. Salazar, 766 F. Supp. 2d 1095, 1107 (D. Mont. 2011) (citing Kilpatrick study regarding brucellosis in bison and cattle).
63. *Id.* at 1101.

native herd.[64] By the 1920s, the bison population had grown so large that the Park Service began donating bison to private ranchers to cull the herd.[65] Congress formally authorized this practice in 1923.[66]

The Yellowstone bison population continued to grow for the next fifty years, and by the 1980s, the Park Service decided to take a hands-off approach to managing it, allowing bison to roam freely within and without the park boundaries.[67] During the 1980s and 1990s, outbreaks of brucellosis, a toxic and contagious disease capable of transmission to humans and domestic livestock, were traced to the Yellowstone bison.[68] To address the contagion issues, the Department of Interior and the managing agencies drafted an Interagency Bison Management Plan (IBMP), which required separation between the bison and livestock herds, to control the brucellosis spread.[69] The agency modified the plan in 2005 to allow bison hunting in the park by private hunters and Native Americans with treaty-based hunting rights.[70] After a 2007 report by the General Accounting Office (GAO) revealed that the agencies had failed to make much progress in moving from step one to step two (of a three-step plan to mitigate brucellosis spread), the agencies prepared an Adaptive Management Plan in 2008 to correct the problems in the GAO report and add necessary metrics to evaluate future progress.[71]

Under the Adaptive Management Plan, the agencies "planned to track the number of bison slaughtered by 'document[ing] the number, age, sex, and sero-status of bison sent to slaughter.'"[72] The agencies needed this evidence "to further one of the goals of the IBMP, which is to reduce the need for lethal removals of bison."[73] Instead of "lethal removals," the Adaptive Management Plan suggested "increased hazing, state and treaty hunting, quarantine, and sending bison to alternate areas."[74] Finally, "[t]he three main goals of the Adaptive Management Plan [we]re to increase tolerance for bison outside the Park to the north and west, to conserve a wild, free-ranging bison population, and to prevent the transmission of brucellosis from bison to cattle."[75] In 2009, an ecological study concluded

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64. *Id.*
65. *Id.*
66. *Id.* at 1101–02.
67. *Id.* at 1102.
68. *Id.* at 1103.
69. *Id.* at 1105.
70. *Id.*
71. *Id.*
72. *Id.*
73. *Id.*
74. *Id.*
75. *Id.*

that the Adaptive Management Plan had worked, and that the risk of transmission of brucellosis from bison to neighboring livestock herds had dropped to "near zero."[76] Therefore, the agencies survived the legal challenge to their decision to adopt the Adaptive Management Plan and avoided the administrative burden of further NEPA analysis of potential impacts to the bison population.[77]

Some agencies have interpreted and implemented adaptive management "in a way that emphasizes those aspects of the paradigm that promote flexibility, discretion, and expedited decision-making, while emphasizing less the aspects that allow for knowledge generation and favor precautious decision-making."[78] The challenge though, is that while "adaptive management is necessitated by the uncertainty inherent in science and management, . . . natural resource politics is driven by the pursuit of certainty and stability."[79]

Other agencies have implemented adaptive management in more of a theoretical manner. As mentioned above, the Forest Service included adaptive management as a goal in its most recent planning regulations in 2005 and 2008.[80] Calling it a "paradigm shift in land management planning," the regulations "embraced the language and some of the core principles of adaptive management."[81] Yet, despite emphasizing a "need for flexibility and adaptability of plans," the agency categorically excluded all National Forest management plans from NEPA analysis;[82] claiming that "[t]o be truly adaptive, [it] wanted to respond to new science, information, and problems more quickly" than every ten years, as contemplated by the formal planning process.[83] Thus, according to the Forest Service, forest plans would be "strategic and aspirational" in nature, and more of a "tentative step in a more adaptive planning process," rather than a document setting substantive management policy and containing real "meat".[84] Taking the agency at its word in these regulations, it seemed that adaptive management might hold true potential to revolutionize the resource planning process. The fact that the process lacked any substantive mandates in the planning rules, combined with exemptions from NEPA

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76. A. Marm Kilpatrick et al., *Wildlife–Livestock Conflict: The Risk of Pathogen Transmission from Bison to Cattle Outside Yellowstone National Park,* 46 J. OF APPLIED ECOLOGY 476, 480–84 (2009).

77. W. Watersheds Project. v. Salazar, 766 F. Supp. 2d 1095, 1107 (D. Mont. 2011).

78. Schultz, *supra* note 35, at 450.

79. *Id.* at 452.

80. *Id.* at 450.

81. *Id.*

82. *Id.*

83. *Id.*

84. *Id.*

review, meant that there was no "backstop" should the adaptive management process fail. Environmental groups, in particular, objected to the 2005 and 2008 planning rules, and federal courts enjoined them based on these flaws.[85]

The FWS also attempted to use adaptive management techniques to comply with the Endangered Species Act, with mixed results. When the Army drafted the ten-year operating plan for Fort Huachuca, the FWS issued a "biological opinion" finding that "the Fort's planned actions were likely to adversely affect several species and outlined specific requirements for water savings and for monitoring of species status."[86] According to the Army,

> the requirements were beyond [its] authority to implement, so it proposed a collaborative approach to water conservation in the watershed. The final biological opinion did not include specific requirements, though, and instead relied on a memorandum of agreement indicating that the Army would undertake development of collaboratively designed mitigation measures within the broader watershed. The opinion gave the Army three years to prepare the regional plan and identify potential conservation measures, but specific requirements were not included and were to be developed over the subsequent three years.

In short, "the no jeopardy opinion was reliant upon the future, successful development of a water conservation strategy, for lands outside of the control of the Army in the larger sub-basin." According to the court, "until such a collaborative approach was in place and mitigation measures had been identified, the Army still had an obligation to show that it was meeting substantive requirements of the ESA." Thus, FWS's attempts to adaptively manage under the Endangered Species Act failed..[87]

II. LIVESTOCK GRAZING ON PUBLIC LANDS: RELEVANT STATUTES, REGULATIONS, AND AGENCY POLICY

85. *Id.* at 451; Citizens for Better Forestry v. U.S. Dep't of Agric., 481 F. Supp. 2d 1059, 1100–01 (N.D. Cal. 2007).

86. Schultz, *supra* note 35, at 460.

87. *Id.*

A. Pre-1930s Federal Grazing Policy

Currently, grazing on the federal range is based on use patterns that arose in the late nineteenth century. In that era, ranchers freely grazed their livestock on the vast grasslands that stretched from Texas to the eastern slope of the Sierra Nevada mountain range in California.[88] Soon after the Civil War ended, the westward moving population started to compete for forage and water on the public range.[89] Until the 1930s, the western federal range was essentially open to all who sought grazing lands for their livestock. In theory, it was a "public domain."[90] However, because the grazing land was typically arid, ranchers required more acreage per head than eastern farmers and ranchers—in some cases, vastly more.

The cattle industry experienced a "boom" in the 1880s, when interest in ranching grew and the total number of livestock grazing the public range reached seven million.[91] Around 1967, large sheep ranching operations began cropping up as well.[92] As more livestock grazed the public range in the latter part of the nineteenth century, forage and available water dwindled, and the fights over these resources became "mini-wars."[93] Ranchers physically tried to block others from grazing their cattle—sometimes by threat of force or by actual acts of violence—by fencing off portions of the range, and by cutting their competition's fences when they blocked travel to water or rail yards.[94]

Calls to regulate the federal range began as early as 1878, when the legendary southwestern explorer, Major John Wesley Powell, fearing water monopoly, wrote that ordinary homesteading laws would not work and pressed Congress to enact "a general law . . . to provide for the organization of pasturage districts."[95] In 1885, Congress passed the Unlawful Enclosures Act, a half-measure intended to stem the private attempts at appropriating public property.[96] This Act provided that "any inclosures of public land in any State or Territory of the United States" were "declared to be unlawful" and the "maintenance, erection, construction, or control of any such inclosure" was "prohibited."[97]

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88. *PLC*, 529 U.S. at 728, 731.
89. *Id.*
90. Nat. Res. Def. Council v. Hodel, 618 F. Supp. 848, 855 (E.D. Cal. 1985).
91. *PLC*, 529 U.S. at 731.
92. *Id.*
93. *Id.* at 732.
94. *Id.*
95. *See id.* (citing Report on the Lands of the Arid Region of the United States, H. Exec. Doc. No. 73, 45th Cong., 2d Sess., 28 (1878)).
96. 43 U.S.C. § 1061 (2006).
97. *Id.*

Similarly, the Act provided that the "assertion of a right to the exclusive use and occupancy of any part of the public lands of the United States . . . is likewise declared unlawful and hereby prohibited."[98] Yet, a "[l]ack of oversight, '[p]opulation growth, forage competition, and inadequate range control all began to have consequences both serious and apparent' for the western rangelands."[99] Because it was "[o]ver-grazed and suffering from a terrible drought, the range was swept by dust storms [,] and '[t]he devastating storms … were in the words of one Senator 'the most tragic, the most impressive lobbyist, that ha[s] ever come to this Capitol.'"[100] Within twenty years of Congress passing the Unlawful Enclosures Act, it became apparent that increased federal regulation of livestock grazing on the public range was necessary. Congress responded, and President Franklin Roosevelt signed the Taylor Grazing Act into law in 1934.[101] This statute is, to this day, the primary legislation governing management of the range resource.

B. Management of Livestock Grazing on Bureau of Land Management Lands

Grazing on lands managed by BLM is governed by the Taylor Grazing Act ("TGA"),[102] Federal Land Policy and Management Act ("FLPMA"),[103] the Public Rangelands Improvement Act ("PRIA"), and agency regulations adopted pursuant to these statutes.[104] The TGA was passed to improve rangeland conditions and "stabilize the western livestock industry" after many years of overgrazing and lack of centralized federal oversight.[105] The TGA authorizes the Secretary of the Interior, and by extension, the Bureau of Land Management, to issue ten-year term grazing permits on public lands not within National Forest boundaries, in exchange "for a reasonable fee."[106] The TGA permits convey no "right, title, interest, or estate in or to" the federal rangelands, but the statute incorporates a preference system allowing those who have historically grazed federal allotments to receive renewal permits as long as they have complied with

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98. *Id.*
99. *Kraayenbrink*, 632 F.3d at 477 (citing Pub. Lands Council v. Babbitt, 529 U.S 728 (2000)).
100. *Id.* (quoting 79 Cong. Rec. 6013 (1935)) (alteration in original).
101. *PLC*, 529 U.S. at 733.
102. 43 U.S.C. § 315(b).
103. *Id.* § 1752(a) (2006).
104. *Id.* § 1901(a)(1) (2006).
105. *Id.* § 315; Nat. Res. Def. Council v. Hodel, 618 F.Supp. 848, 856 (E.D. Cal. 1985) (discussing the purpose of the Taylor Grazing Act).
106. 43 U.S.C. § 315(b)(2006).

the terms and conditions of the permit and any applicable federal regulations.[107] The TGA is considered by many to have "closed" the public range, bringing the administration and management of grazing on BLM lands within the sole discretion of the Secretary of the Interior.[108]

Pursuant to the TGA, the Secretary of the Interior can "make provision for the protection, administration, regulation, and improvement of [all] grazing districts," and

> do any and all things necessary to accomplish the purposes of this subchapter and to insure the objects of such grazing districts, namely, to regulate their occupancy and use, to preserve the land and its resources from destruction or unnecessary injury, to provide for the orderly use, improvement, and development of the range; and the Secretary of the Interior is authorized to continue the study of erosion and flood control and to perform such work as may be necessary amply to protect and rehabilitate the areas subject to the provisions of this subchapter.[109]

As of 1937, the Department of Interior promulgated the first set of "basic rules for allocation of grazing privileges."[110] The rules expressly "recognized that many ranchers had long maintained herds on their own private lands during part of the year, while allowing their herds to graze farther afield on public land at other times."[111] Thus, the rules "gave a first preference to owners of stock who also owned 'base property,' i.e., private land (or water rights) sufficient to support their herds, *and* who had grazed the public range during the five years just prior to the Taylor Act's enactment."[112] The rules awarded "a second preference to other owners of nearby 'base' property lacking prior use,"[113] and "a third preference to stock owners without base property, like the nomadic sheep herder."[114] Because "lower preference categories divided capacity left over after satisfaction of

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107. 43 U.S.C. § 315(b).
108. *Hodel*, 618 F. Supp. at 855.
109. 43 U.S.C. § 315(a).
110. *PLC*, 529 U.S. at 734.
111. *Id.*
112. *Id.* (citing 2 App. 818–819 (Rules for Administration of Grazing Districts) (June 14, 1937)).
113. *Id.* at 734–35 (quoting 2 App. 818–19).
114. *Id.* at 735.

all higher preference claims, this system, in effect, awarded grazing privileges to owners of land or water."[115]

Yet, the TGA did not accomplish its purposes of improving range conditions, and "[n]early three decades after [its] enactment, however, the Department of Interior had failed to achieve the first of the Act's stated goals, namely, to halt the degradation of the public grasslands."[116] By 1962, according to a BLM survey, "83.4 percent of the public grasslands remained in fair or poor condition."[117]

Moreover, according to a 1975 BLM study, only "19% of the acres under its control were 'improving,' while 65% were 'static,' and 16% were admittedly 'declining.'"[118] The agency admitted these estimates were conservative.[119] By 1976, Congress felt pressure to enact further legislation to improve environmental conditions on all public lands, including the federal range, which resulted in the passage of the Federal Lands Policy Management Act ("FLPMA") of 1976.[120]

In FLPMA, Congress denounced past BLM grazing management practices, stating that "a substantial amount of the Federal range lands is deteriorating in quality," and noted that "additional range improvements could arrest much of the continuing deterioration and could lead to substantial betterment of forage conditions with resulting benefits to wildlife, watershed protection, and livestock production."[121] Thus, in FLPMA, Congress instructed BLM to manage federal public lands:

> in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy use.[122]

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115. *Id.*

116. *Kraayenbrink*, 632 F.3d at 478 (citing Pub. Lands Council v. Babbitt, 529 U.S 728 (2000)).

117. *Id.*

118. Bureau of Land Mgmt., RANGE CONDITION REPORT vi (Washington D.C.: U.S. Government Printing Office, 1975).

119. *Id.*

120. Federal Lands Policy Mgmt. Act of 1976, 43 U.S.C. §§ 1701–87 (2006).

121. *Id.* § 1751(b).

122. *Id.* § 1751(b).

BLM grazing permits must comply with FLPMA, which requires the agency to develop and implement "land use plans for the public lands it administers with a goal of improving resource conditions and avoiding 'undue degradation' of the land."[123] To comply with these mandates, BLM must design its resource management plans to strike "a balance among the many competing uses to which land can be put."[124] Yet, while FLPMA reaffirms the statutory regime set forth in the TGA, it allows the BLM to "cancel, suspend, or modify" a permit "in whole or in part" if the permittee violates any of the provisions of applicable law or the terms of the permit itself, such as grazing too many or too few animals, pasturing during an impermissible time of year, and constructing or maintaining improvements without agency approval.[125]

A few years after passing FLPMA, Congress acted again in response to further reports of federal rangeland degradation caused by livestock grazing, passing the Public Rangeland Improvements Act ("PRIA") of 1978.[126] PRIA was yet another reminder to BLM that "vast sections" of the public rangeland were in "an unsatisfactory condition," and "producing less than their full potential."[127] Specifically, Congress noted that continuing past management practices would:

> present a high risk of soil loss, desertification, and a resultant underproductivity for large acreages of the public lands; contribute significantly to unacceptable levels of siltation and salinity in major western watersheds including the Colorado River; negatively impact the quality and availability of scarce western water supplies; threaten important and frequently critical fish and wildlife habitat; prevent expansion of the forage resource and resulting benefits to livestock and wildlife production; increase surface runoff and flood danger; reduce the value of such lands for recreational and esthetic purposes; and may ultimately lead to unpredictable and undesirable long-term local and regional climatic and economic changes.[128]

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123. W. Watersheds Project. v. BLM, 721 F.3d 1264, 1268 (10th Cir. 2013) (citing 43 U.S.C. §§ 1712(a), 1732(b)).

124. New Mexico *ex rel.* Richardson v. BLM, 565 F.3d 683, 690 n.3 (10th Cir. 2009).

125. Nat. Res. Def. Council, Inc. v. Hodel, 618 F. Supp. 848, 859 (E.D. Cal. 1985).

126. 43 U.S.C. § 1901(a)(1) (2006).

127. *Id.*

128. 43 U.S.C § 1901(a)(3) (2006).

On a more localized level, the BLM has the authority to develop allotment management plans for each individual grazing allotment under its management authority.[129] In addition to prescribing "(1) the number, (2) kind, (3) and class of livestock, (4) the allotment to be grazed, and (5) the period of use," allotment management plans may also contain other terms the BLM deems necessary, as long as they are "tailored to the specific range condition of the area."[130] However, the BLM may issue permits when there is no allotment management plan in place, if the permit itself includes: (1) "the number of animals to be grazed" by the permittee; (2) "the seasons of use" for livestock grazing; and (3) a provision that the Secretary "may reexamine the condition of the range at any time" and, if necessary, "readjust" the livestock grazing prescription for the allotment.[131] Individual management decisions can be incorporated into the permit itself, or into the BLM's annual grazing authorization.[132] The annual grazing authorization "sets the parameters for the upcoming grazing season."[133]

The regulations governing allotment management plans and annual operating instructions include several specific mandates related to the ecological health of the federal range.[134] First, they require that:

> Watersheds are in, or are making significant progress toward, properly functioning physical condition, including their upland, riparian-wetland, and aquatic components; soil and plant conditions support infiltration, soil moisture storage, and the release of water that are in balance with climate and landform and maintain or improve water quality, water quantity, and timing and duration of flow.[135]

Second, the regulations require that: "[e]cological processes, including the hydrologic cycle, nutrient cycle, and energy flow, are maintained, or there is significant progress toward their attainment, in order to support healthy biotic populations and communities."[136] Third, water quality must "compl[y] with State water quality standards and achieves, or . . . mak[e] significant progress toward achieving, established BLM management

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129. *Hodel*, 618 F. Supp. at 859.

130. McKeen v. U.S. Forest Serv., 615 F.3d 1244, 1247 (10th Cir. 2010); 43 U.S.C. §§ 1702(k), 1752(d).

131. *Hodel*, 618 F. Supp. at 860.

132. W. Watersheds Project v. BLM, 629 F. Supp.2d 951, 971 (D. Ariz. 2009).

133. *Id.* at 971 (quoting ONDA v. U.S. Forest Serv., 465 F.3d 977, 983 (9th Cir. 2006)).

134. *Kraayenbrink*, 632 F.3d at 480 (citing 43 C.F.R. § 4180.1, 4180.2(c)).

135. 43 C.F.R. § 4180.1 (2006).

136. *Id.*

objectives such as meeting wildlife needs."[137] Finally, the regulations require that decisions related to habitats must result in habitats that are "or are making significant progress toward being, restored or maintained for Federal threatened and endangered species, Federal proposed or candidate threatened and endangered species, and other special status species."[138] Thus, any allotment management plan, or permit issued in the absence of an allotment management plan, must contain some criteria related to any of the relevance benchmarks in the Fundamentals of Rangeland Health regulations.

C. Management of Livestock Grazing on National Forest Lands

Within national forests, the United States Forest Service regulates grazing under three primary statutes: the National Forest Management Act ("NFMA"),[139] the Granger-Thye Act,[140] and the Federal Lands Policy and Management Act ("FLPMA").[141] Originally, Congress authorized livestock grazing on allotments within national forests in section 19 of the Granger-Thye Act of 1950.[142] The Forest Service must also comply with NFMA's requirements of forest-wide planning,[143] as well as FLPMA's requirements regarding Allotment Management Plans,[144] individual grazing permits,[145] and Annual Operating Instructions.[146] Each step of this decision-making process must also comply with FLPMA's "multiple use" and "sustained yield" mandates.[147] An examination of the potential role of adaptive management as a tool for managing grazing in national forests requires a detailed understanding of each type and level of management decision.

A Forest Plan is a "broad, programmatic document, accompanied by an Environmental Impact Statement and public review process conducted in accordance with the National Environmental Policy Act."[148] Each Forest Plan must accommodate multiple and different uses, and "coordinate the management of 'outdoor recreation, range, timber, watershed, wildlife and

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137. *Id.*
138. *Id.*
139. 16 U.S.C. § 1604 (2006).
140. *Id.* § 5801 (2006).
141. 43 U.S.C. §§ 1751–53 (2006).
142. 16 U.S.C. § 5801.
143. *Id.* § 1604(a) (2006).
144. 43 U.S.C. § 1752(d).
145. *Id.* § 1752(a).
146. McKeen v. U. S. Forest Serv., 615 F.3d 1244, 1246–47 (10th Cir. 2010).
147. Buckingham v. Sec'y of U.S. Dep't of Agric., 603 F.3d 1073, 1076–77 (9th Cir. 2010).
148. Colo. Envtl. Coal. v. Dombeck, 185 F.3d 1162, 1167–68 (10th Cir. 1999) (citing 42 U.S.C. §§ 4331–4370 (2010)).

fish, and wilderness.'"[149] In a Forest Plan, large areas of National Forest are designated for one or more of these uses, limited only by a general mandate that the agency "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."[150]

The regulations governing grazing use on Forest Service allotments also provide that "each allotment will be analyzed and with careful and considered consultation and cooperation with the affected permittees, landowners, and grazing advisory boards involved, as well as the State having land within the area covered, and an allotment management plan developed."[151] An Allotment Management Plan ("AMP") "prescribes the manner in and extent to which livestock operations will be conducted in order to meet the multiple-use, sustained yield, economic, and other needs and objectives as determined" for each allotment of a National Forest.[152] An AMP must be "consistent with the Forest Plan for the forest in which the allotment sits."[153] Moreover, the Plan "relates the directives of the applicable Forest Plan to the individual grazing allotment."[154]

In addition to the agency planning documents, each allotment carries an individual permit, which a party must obtain before grazing any Forest Service allotment.[155] The permit terms must comply with the pertinent Forest Plan and AMP.[156] According to the applicable regulations, grazing permits must specify the "(1) the number, (2) kind, (3) and class of livestock, (4) the allotment to be grazed, and (5) the period of use."[157] Grazing permits have a term of ten years, and once a permit is granted, the permittee has a statutory right of first refusal to renew it when the permits term ends, as long as no permit terms were violated during the preceding term.[158]

Finally, the Forest Service issues Annual Operating Instructions ("AOI") to "set forth the parameters of the permit holder's license for the upcoming year."[159] Because AOIs are issued every year, they are

149. *McKeen*, 615 F.3d at 1247 (quoting 16 U.S.C. § 1604(e)(1)).
150. *Id.* (quoting 16 U.S.C. § 1604(g)(3)(B)).
151. 36 C.F.R. § 222.2 (2013).
152. *Id.* § 222.1(b)(2)(i)(2013).
153. *McKeen*, 615 F.3d at 1247.
154. *Id.* (quoting Or. Nat. Desert Ass'n v. U.S. Forest Serv. (ONDA), 465 F.3d 977, 980 (9th Cir. 2006)).
155. 43 U.S.C. § 1752(a).
156. *McKeen*, 615 F.3d at 1247 (quoting 36 C.F.R. § 222.3(c)(1)).
157. *Id.* (quoting ONDA, 465 F.3d at 980).
158. 43 U.S.C. §§ 1752(a), 1752(c); 36 C.F.R. § 222.3(c)(1) (2013).
159. *McKeen*, 615 F.3d at 1247.

> responsive to conditions that the Forest Service could not or may not have anticipated and planned for in the AMP or grazing permit, such as drought conditions, timing and duration of rainfall over the grazing season, success or failure of habitat restoration projects, water quality, or degree of risk to threatened or endangered species affected by grazing.[160]

At each of the four levels of its planning process, the Forest Service can make adjustments to range use consistent with environmental conditions, but the AOIs provide the best opportunity for an immediate response to changed environmental conditions on any given allotment or within any larger ecosystem.

III. CLIMATE CHANGE AND NATURAL RESOURCE MANAGEMENT

Climate change "confronts natural resource managers . . . with ecological disturbance on a massive scale."[161] The concept of global warming and its potential effects on natural resource management have been part of the federal regulatory dialogue since the 1970s.[162] The current scientific perspective is that climate change will likely shift "temperature regimes" and "hydrological cycles," alter ecosystems in uncertain ways, and possibly create the largest global extinction "event" in 65 million years.[163] According to scientists, climate change will inexorably alter local and regional forage patterns, rendering currently arid locations even drier, and causing desertification on a massive scale.[164] Even currently forested areas may be at risk of becoming arid savannah.[165]

Since the 1970s, the federal government has been grappling with how to manage natural resources with the certainty that the climate in the western United States will change, but not knowing exactly to what degree or the rate at which this change will occur. In the latter part of that decade, "the Federal Government began devoting serious attention to the possibility that carbon dioxide emissions associated with human activity could provoke climate change."[166] In 1978, Congress passed the National Climate Program Act, authorizing a program to "assist the Nation and the world to

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160. *Id.* at 1248 (quoting ONDA, 465 F.3d at 980–81).

161. Daniel Schramm & Akiva Fishman, *Legal Frameworks for Adaptive Natural Resource Management in a Changing Climate*, 22 GEO. INT'L ENVTL. L. REV. 491, 491 (2010).

162. Massachusetts v. EPA, 549 U.S. 497, 507–08 (2007).

163. Schramm & Fishman, *supra* note 162, at 492.

164. *Id.* at 493.

165. *Id.*

166. *Mass. v. EPA*, 549 U.S. at 507.

understand and respond to natural and man-induced climate processes and their implications."[167] In 1979, the National Academy of Sciences issued a report stating: "[i]f carbon dioxide continues to increase, the study group finds no reason to doubt that climate changes will result and no reason to believe that these changes will be negligible . . . A wait-and-see policy may mean waiting until it is too late."[168]

In 1987, Congress passed the Global Climate Protection Act, "finding that 'manmade pollution—the release of carbon dioxide, chlorofluorocarbons, methane, and other trace gases into the atmosphere—may be producing a long-term and substantial increase in the average temperature on Earth.'"[169] In the Act, Congress instructed the EPA to develop a "'coordinated national policy on global climate change,' and ordered the Secretary of State to work 'through the channels of multilateral diplomacy' and coordinate diplomatic efforts to combat global warming."[170] Moreover, Congress noted that "ongoing pollution and deforestation may be contributing now to an irreversible process" and that "[n]ecessary actions must be identified and implemented in time to protect the climate."[171]

In 1992, President George H.W. Bush attended the first Earth Summit in Rio de Janeiro, Brazil and signed the United Nations Framework on Climate Change (UNFCC), "a nonbinding agreement among 154 nations to reduce atmospheric concentrations of carbon dioxide and other greenhouse gases for the purpose of 'preventing dangerous anthropogenic interference with the [Earth's] climate system.'"[172] Five years later, "after the IPCC [Intergovernmental Panel on Climate Change] issued a second comprehensive report in 1995 concluding that '[t]he balance of evidence suggests there is a discernible human influence on global climate,' the UNFCC signatories met in Kyoto, Japan, and adopted a protocol that assigned mandatory targets for industrialized nations to reduce greenhouse gas emissions."[173] The Kyoto Protocol, as it became known, was eventually signed by 192 countries, including most of Europe and the United States.[174]

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167. *Id.* at 507–08.

168. *Id.* at 508 (quoting CLIMATE RESEARCH BOARD, CARBON DIOXIDE AND CLIMATE: A SCIENTIFIC ASSESSMENT, viii (1979)).

169. *Id.* (quoting congressional findings in note following 15 U.S.C. § 2901).

170. *Id.* (quoting 15 U.S.C. §§ 1103(b), 1103(c)).

171. 15 U.S.C. § 2901(4) (2006).

172. Massachusetts v. EPA, 549 U.S. 497, 509 (2007) (describing the nature and purpose of the UNFCCC treaty signed by the US in 1992).

173. *Id.* (quoting IPCC, CLIMATE CHANGE 1995, THE SCIENCE OF CLIMATE CHANGE, 4).

174. United Nations, *Status of Ratification of the Kyoto Protocol*, http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php (last visited Nov. 20th, 2013).

In 2001, the National Research Council issued a report, concluding that "[g]reenhouse gases are accumulating in Earth's atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise. Temperatures are, in fact, rising."[175] The impacts of this rise in global temperatures will affect various geographical areas differently, and in ways that are somewhat uncertain. Scientists monitoring the impacts of climate change in the western United States have determined that climate change will affect western ecosystems in a variety of ways, "including decreased snowpack, earlier snow melt, increased winter rain, peak winter flows and flooding, and reduced summer flows."[176]

Moreover, the Global Climate Models, which are "highly sophisticated computer representations of the global climate system—the atmosphere, the oceans, ice sheets and sea ice, and the land surface—"indicate the Intermountain West "will warm by 2.5 [degrees] by 2025," and "4 degrees . . . by 2050."[177] It is less certain how climate change will impact the overall water supply in the western United States, but scientist agree there will likely be increased precipitation in the winter months and decreased precipitation in the summer months.[178] The increased ambient air temperatures will also likely result in increased evaporation of surface water.[179]

Studies also show precipitation patterns will change across the United States as well, with the west and southwest experiencing less rainfall and the east and northeast experiencing more.[180] As the west and southwest continue to warm and dry out, the possibility of mega-droughts unrelated to climate change may also increase, and the models predict that the total surface water supply will decline.[181] There will also be peripheral impacts to western rangelands, such as increased fires, pests, increased dust loads on

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175. COMM. ON THE SCI. OF CLIMATE CHANGE, NAT'L RESEARCH COUNCIL, CLIMATE CHANGE SCIENCE: AN ANALYSIS OF SOME KEY QUESTIONS 1 (2001)

176. Bobbie Klein & Douglas Kenney, *The Land Use Planning, Water Resources and Climate Change Adaptation Connection: Challenges and Opportunities*, http://sciencepolicy.colorado.edu/admin/publication_files/resource-2729-2009.15.pdf (last visited Oct. 29, 2013).

177. *Climate Change Projections, in Western Water Assessment*, U. OF COLO. BOULDER (2013), http://wwa.colorado.edu/climate/change.html (last visited Oct. 23, 2013).

178. *Id.*; Karen Cozzetto et al., *Examining Regional Climate Model (RCM) Projections: What Do They Add to Our Picture of Future Climate in the Region?*, 7 Intermountain West Climate Summary 1, 5 (2011), http://wwa.colorado.edu/climate/iwcs/docs/2011_July/IWCS_July2011_Feature.pdf.

179. *Id.* at 5.

180. Udall Presentation, *supra* note 7.

181. *Id.*

snowpack, and other unknowns.[182] Meanwhile, as populations increase in western cities, the total available water supply will decline.[183]

Finally, although scientists have reached consensus on the these general changes, they agree it is difficult to predict precisely how they will impact a given area over the short or long term, in light of all of the variables.[184] So, while scientists can tell range managers there will be less precipitation in the western United States than there will be in the eastern United States, and temperatures in the western United States will warm consistently by a few degrees over the next fifty years; they cannot predict, at this point, how those changes will affect forage patterns or water supply on a localized level.[185] The temperature changes might cause increased precipitation during certain months of the year, and decreased precipitation during others, and the impacts of some changes spurred by a drier climate (such as increased dust load on mountain snow fields or increased spruce beetle populations) are difficult to predict given the lack of historical evidence about what results to expect.

IV. ADAPTIVE MANAGEMENT OF THE FEDERAL RANGE IN LIGHT OF CLIMATE CHANGE IMPACTS

Given the certainty that climate change will alter the federal range resource itself, as well as resources like water, on which the use of the federal range heavily depends, federal agencies will soon be faced with the prospect of having to make management decisions to account for climate change impacts, or to recover from them. These decisions, and the agencies' overall management strategy, must be iterative, rather than closed, because of the scale of climate change impacts and the uncertainty involved. The only existing iterative resource management strategy is adaptive management, which agencies have already begun to use, albeit in more discrete circumstances.

The BLM for instance, has used adaptive management for the past two decades in various contexts, such as endangered species management and water allocation.[186] The BLM has also used adaptive management in some districts to manage grazing, cultural resources, and endangered species habitat on the federal range. Courts have generally been supportive of this

182. *Id.*
183. *Id.*
184. *Id.*
185. *Id.*
186. Feller, *supra* note 55, at 898.

effort, particularly as it relates to challenges under NEPA.[187] Typically, the agency will incorporate adaptive management at the level of the Resource Management Plan, the Allotment Management Plan, and the Annual Operating Instructions.[188] The Resource Management Plan will set forth the overall goal, and establish parameters for measuring the validity of agency hypotheses regarding rangeland impacts, which the agency can then monitor, or test, and implement changes through the individual Allotment Management Plan or the Annual Operating Instructions.[189] Should the agency fail to conduct monitoring to test the effectiveness of the initial management decision, or implement strategies that are inadequate to address changed circumstances, interested parties can petition the courts to review those decisions under NEPA.[190]

The courts have generally given BLM a fair amount of latitude in developing and implementing adaptive management strategies on the federal range.[191] For example, in Oregon, BLM has used adaptive management to set grazing levels in various grazing districts throughout the state, at the Resource Management Plan level, which the federal courts have respected.[192] Courts have protected BLM from litigation regarding how it incorporates adaptive management techniques, as long as the agency appears to be following the general guidelines set in the Resource Management Plan.[193] If however, the agency declines to adjust its management decisions at the individual Allotment Management Plan level, or in the Annual Operating Instructions, despite monitoring data indicating a need to do so, the agency's actions would be subject to judicial review under NEPA.[194] Moreover, courts have indicated that the BLM's adaptive management strategy cannot be "so amorphous and ill-defined" that it is "unable to determine" environmental consequences of its actions, or it could be held to violate NEPA's "hard look" requirement.[195]

In light of the broad discretion courts give the agencies to incorporate adaptive management, agencies can and should utilize it on a much broader scale to address the uncertainties posed by climate change. For instance,

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187. W. Watersheds Project. v. U.S. Forest Serv., No. 4: 09-CV-629-BLW, 2011 WL 4442668, at 3 (D. Idaho 2011); Wilderness Soc'y v. BLM, 822 F. Supp.2d 933, 942 (D. Ariz. 2011).

188. W. Watersheds Project. v. Salazar, 843 F. Supp.2d 1105, 1129 (D. Idaho 2012).

189. *See generally id.* at 1128 (holding that BLM failed to conduct effective testing under NEPA).

190. *Id.*

191. Or. Nat. Desert Ass'n v. Shuford, 2007 WL 1695162, at *13 (D. Or. 2007).

192. *Id.*; Or. Nat. Desert Ass'n v. BLM, 2005 WL 711663, at *2–3 (D. Or. 2005).

193. *Id.* at 2.

194. *Id.*

195. Theodore Roosevelt Conservation P'ship v. Salazar, 605 F. Supp. 2d 263, 279 (D.D.C. 2009).

agencies like the BLM and Forest Service know that temperatures will warm by several degrees in the southwestern states, which will impact forage and water availability in somewhat predicable ways (less forage and less surface water).[196] Thus, when revising land or resource management plans under FLPMA, the agencies could use that outcome to lower the Animal Unit Month ("AUM") levels on all allotments in the southwestern states, to a degree that might maintain adequate forage. Then, the agencies can develop plans to monitor forage availability in light of temperatures and water supply to determine if the across-the-board decision to lower AUMs was effective, conduct the monitoring, and make any necessary adjustments in AUMs based on the results. This can be done for an individual allotment in an Allotment Management Plan or Annual Operating Instructions, or region-wide, in a Resource Management Plan or Forest Management Plan, depending on the type of allotment.

Similarly, the scientific community has predicted that the overall water supply (including precipitation and groundwater) will decline in the southwestern United States, as it increases in the northeastern United States.[197] This will also impact allotment grazing patterns and AUM levels, given that forage growth is dependent on the atmospheric water supply and livestock survival is dependent on privately held water rights used in connection with federal allotments. While it is difficult to regulate based on the latter concern, given that individual ranchers could simply acquire water rights to offset any losses to existing water sources, for the purposes of stock water, the decline in atmospheric water and its impact on forage growth cannot be privately mitigated. The agencies will have to manage forage allocation, through pasture rotation or decreased overall AUMs, because of the climate model predictions, regardless of private water right holdings by individual permittees. These changes can also be incorporated immediately, through the Annual Operating Instructions, or on a longer-term basis by way of the Allotment Management Plan, Resource Management Plan, or Forest Plan.

The potential roadblocks facing the Forest Service and BLM in their use of adaptive management are fairly certain, given the historical record as reflected in judicial opinions. Under NEPA, for example, if an agency incorporates adaptive management into one of the planning stages, the planning document must be specific as to monitoring and performance goals, as well as contain detailed mitigation methods; otherwise a court may

196. Udall Presentation, *supra* note 7.
197. *Id.*

invalidate it.[198] However, the mitigation methods need not be fixed, and courts have held they can be "adaptable" over time.[199] Similarly, a court might invalidate an Adaptive Management Plan that does not comply with NFMA's disclosure requirement, which requires transparency in an agency's record of decision.[200] If these known problems are avoided, adaptive management provides a sound basis for managing natural resource use in a constantly changing climate.

CONCLUSION

At first glance, the retrospective nature of federal grazing law seems like an unlikely fit for the forward-looking theory of adaptive management. However, Congress has left adequate gaps in the statutes governing livestock grazing on the federal range for the Forest Service and BLM to use adaptive management strategies to manage this resource for a changing global climate. Given that Congress is unlikely to modify the basic statutory structure governing livestock grazing on public lands, and that the agencies have largely failed in their attempts at substantive regulatory range reform, it is clear that a new strategy is needed. Because climate change has already begun to impact the federal range in known ways, and it will continue to do so in somewhat predictable ways for the foreseeable future, the Forest Service and BLM will have to find a way to manage for climate change within the existing statutory framework.

Adaptive management is currently the only theory already in use that will allow the agencies to do so in a flexible, iterative manner. Moreover, agencies will require flexibility given that they know the climate will change in certain ways (less overall water, increased temperatures), but they can only make a "best-guess" determination as to what other impacts will result (dust load on snow pack, beetles, and others). Adaptive management is a viable theory that provides this level of flexibility both at the outset and upon implementation. Lastly, adaptive management allows agencies to manage entire ecosystems, rather than discrete resources under discrete statutes. Thus, it is a management approach that is well suited to address a global environmental crisis like climate change on a regional level, based on the individual circumstances facing the public range in any given area.

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198. *See* Theodore Roosevelt Conservation P'ship, 607 F. Supp.2d at 279 (listing some of BLM's specific monitoring goals).

199. *Id.* at 280.

200. Sierra Forest Legacy v. Sherman, 646 F.3d 1161, 1200 (2011).