ARTICLES

De- and Re-constructing Public Governance for Biodiversity Conservation

*Alejandro E. Camacho**

To argue that the current extinction event could be averted if people just cared more and were willing to make more sacrifices is not wrong, exactly; still, it misses the point. It doesn't much matter whether people care or don't care. What matters is that people change the world.

—Elizabeth Kolbert[1]

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1. ELIZABETH KOLBERT, THE SIXTH EXTINCTION: AN UNNATURAL HISTORY 266 (2014).

INTRODUCTION

Is biodiversity loss wicked? What has been done about it? And how might public governance be altered to improve the prognosis? A substantial and growing number of scholars have sought to define and characterize incredibly complex social problems, alternatively labelled as "messes,"[2] "swamp[s],"[3] "massive,"[4] "wicked,"[5] or even "super wicked" problems.[6]

Biodiversity loss, or the decline in variation among genes, species, and functional traits in a particular area,[7] has been characterized by some as a classic wicked problem.[8] Scientists agree on an ongoing biodiversity crisis worldwide.[9] Though the focus is often on species extinction risk,[10] other indicators of biodiversity, including ecosystem extent and condition, biotic integrity, and total biomass, have all deteriorated sharply from the prehistorical baseline.[11] Other major dangers include the rising losses in genetic diversity within species (reducing resilience to the effects of climate change due to fewer potential favorable adaptations),[12] functional diversity (or the presence of multiple species that fulfill similar roles in an ecosystem), and overall ecosystem function (or the benefits or services that an ecosystem provides).[13] The challenges in defining the problem and potential

2. Russell L. Ackoff, *The Art and Science of Mess Management*, 11 INTERFACES 20, 22 (1981).

3. DONALD A. SCHÖN, EDUCATING THE REFLECTIVE PRACTITIONER: TOWARD A NEW DESIGN FOR TEACHING AND LEARNING IN THE PROFESSIONS 3 (1987).

4. *See, e.g.*, J.B. Ruhl & James Salzman, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: A Guide for Whittling Away*, 98 CALIF. L. REV. 59, 64 (2010).

5. *See, e.g.*, Horst W.J. Rittel & Melvin M. Webber, *Dilemmas in a General Theory of Planning*, 4 POL'Y SCIS. 155, 160–61 (1973).

6. *See, e.g.*, Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future*, 94 CORNELL L. REV. 1153, 1160 (2009).

7. Bradley J. Cardinale, J. Emmett Duffy, Andrew Gonzalez, David U. Hooper, Charles Perrings, Patrick Venail, Anita Narwani, Georgina M. Mace, David Tilman, David A. Wardle, Ann P. Kinzig, Gretchen C. Daily, Michel Loreau, James B. Grace, Anne Larigauderie, Diane S. Srivastava & Shahid Naeem, *Biodiversity Loss and Its Impact on Humanity,* 486 NATURE 59, 60 (2012). Biodiversity loss thus includes species extinction but more broadly consists of any decline from the genetic to the ecological scale. *See id.*; *see also infra* Section V.A.

8. *See, e.g.*, Martin Sharman & Musa C. Mlambo, *Wicked: The Problem of Biodiversity Loss*, 21 GAIA 274, 274 (2012).

9. *See, e.g.*, INTERGOVERNMENTAL SCI.-POL'Y PLATFORM ON BIODIVERSITY & ECOSYSTEM SERVS., SUMMARY FOR POLICYMAKERS OF THE IPBES GLOBAL ASSESSMENT REPORT ON BIODIVERSITY AND ECOSYSTEM SERVICES 10–12 (2019) [hereinafter IPBES SUMMARY].

10. *See id.* at 24 (reporting that approximately 12.5 percent of all species worldwide are threatened with extinction).

11. *See id.* at 25 (reporting that ecosystem extent and condition has declined by forty-seven percent on average, biotic integrity in terrestrial communities by twenty-three percent, and global biomass of wild mammals by eighty-two percent).

12. *See id.* at 25–26 (reporting that "[t]en per[ ]cent of domesticated breeds of mammals were recorded as extinct," and genetic diversity in wild species worldwide has declined an average of one percent per decade since the mid-nineteenth century); *see also* M. Bálint, S. Domisch, C.H.M. Engelhardt, P. Haase, S. Lehrian, J. Sauer, K. Theissinger, S.U. Pauls & C. Nowak, *Cryptic Biodiversity Loss Linked to Global Climate Change*, 1 NATURE CLIMATE CHANGE 313, 317 (2011).

13. *See* IPBES SUMMARY, *supra* note 9, at 22 (discussing the fact that the "deterioration of nature and consequent disruption of benefits to people has both direct and indirect implications"

solutions, the multiplicity and interconnectivity of drivers and consequences, as well as other features of biodiversity loss have led scholars to consider it wicked and even super wicked.[14]

A more useful question, however, might be how much does the wicked label matter. Some criticize the wicked problem nomenclature as merely a rhetorical turn: an increasingly, and perhaps indiscriminately, used shorthand for identifying very complicated, and perhaps even intractable, problems.[15] Indeed, a wicked label is likely only relevant if such a designation helps formulate approaches for addressing the problem.

Perhaps the essential inquiry, then, is what can be done to manage the dilemma. Some do consider the wicked problem tag to be valuable for identifying effective responses,[16] including for managing biodiversity loss.[17] Undoubtedly, proposals for untangling wicked problems abound. Virtually all of these proposals, however, focus on the procedural facets of public governance, with a procession of scholars offering ways to improve decisionmaking processes to rein in wicked problems.[18]

While some attention to process may be warranted, managing complex problems like biodiversity loss also requires consideration of other core elements of governance. Governance can best be understood as having substantive, procedural, and structural facets.[19] As Professor

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for various aspects of society); *see also* Jae R. Pasari, Taal Levi, Erika S. Zavaleta & David Tilman, *Several Scales of Biodiversity Affect Ecosystem Multifunctionality*, 110 PROC. NAT'L ACAD. SCIS. 10219, 10219 (2013).

14. *See infra* Section I.A.

15. *See, e.g.*, Nick Turnbull & Robert Hoppe, *Problematizing 'Wickedness': A Critique of the Wicked Problems Concept, from Philosophy to Practice*, 38 POL'Y & SOC'Y 315, 316 (2019) (describing "rhetorical appeal" of wicked terminology "as when used by practitioners to avoid blame for policy failure, or to draw attention and resources to certain problems"); *id.* at 333; B. Guy Peters, *What Is So Wicked About Wicked Problems? A Conceptual Analysis and a Research Program*, 36 POL'Y & SOC'Y 385, 386 (2017) ("[D]escribing [difficult] policy problems as wicked problems has become a fad in the academic literature."); John Alford & Brian W. Head, *Wicked and Less Wicked Problems: A Typology and a Contingency Framework*, 36 POL'Y & SOC'Y 397, 398 (2017) ("[T]he term 'wicked problem' has become inflated and over-used.").

16. *See, e.g.*, Catrien J.A.M. Termeer, Art Dewulf & Robbert Biesbroek, *A Critical Assessment of the Wicked Problem Concept: Relevance and Usefulness for Policy Science and Practice*, 38 POL'Y & SOC'Y 167, 176 (2019) ("[T]he concept of wicked problems has important rhetorical effects in research and practice.").

17. *See, e.g.*, Sharman & Mlambo, *supra* note 8, at 274 ("[I]t is crucial to understand biodiversity loss as a wicked problem[ ] in order to facilitate innovative and comprehensive approaches to dealing with it.").

18. *See infra* Section I.B.

19. *See* Alejandro E. Camacho & Robert L. Glicksman, *Legal Adaptive Capacity: How Program Goals and Processes Shape Federal Land Adaptation to Climate Change*, 87 U. COLO. L. REV. 711, 724–34 (2016) [hereinafter *Legal Adaptive Capacity*] (defining the substantive and procedural components of legal adaptive capacity); ALEJANDRO E. CAMACHO & ROBERT L.

J.B. Ruhl has noted, it is "important to distinguish between the resilience of the legal system's underlying structure and processes and the stability of the substantive content of law."[20] Each of these facets affects the legal system's adaptive capacity to manage complexity and uncertainty—in other words, to cope with wickedness. Policymakers might more effectively tackle wicked problems like biodiversity loss by reconstructing public governance to enhance not only procedural but also substantive and structural legal adaptive capacity.

This Article deconstructs the substantive, procedural, and structural components of public governance in the United States to explain how the existing legal infrastructure lacks the legal adaptive capacity to manage the wickedness of biodiversity loss. That is, particularly in the context of global anthropogenic climate change, the substantive goals and tools of public action, the processes used by governmental institutions to advance such goals and implement such tools, and the structure of allocated authority among public institutions have been devised in ways that make biodiversity loss virtually impossible to tackle meaningfully.

First, the substantive goals of natural resources law are not primarily directed at promoting biodiversity or broader notions of ecological health.[21] Indeed, the range of tools conventionally employed for achieving such regulatory goals are primarily directed at one of several objectives that, at best, have only indirectly been aimed at promoting some version of biodiversity: minimizing direct human harm or other interventions, maintaining historical conditions, or maximizing resource yield. The few more recent interventions that are better directed at promoting ecological health remain rare and inadequate. As a result, it would be misleading to state that we have even attempted to address the biodiversity crisis through governance in any meaningful way.

Second, public biodiversity governance lacks procedural legal adaptive capacity. The conventional regulatory and management processes adopted for advancing prevailing natural resource goals and for deciding when and how to employ such strategies are insufficiently tethered to managing both the uncertainties and the dynamics accompanying ecological phenomena.[22] Significant opportunities

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GLICKSMAN, REORGANIZING GOVERNMENT: A FUNCTIONAL AND DIMENSIONAL FRAMEWORK 236–37 (2019) [hereinafter REORGANIZING GOVERNMENT] (distinguishing structural legal adaptive capacity).

20. 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, 1383 (2011).

21. *See infra* Part II.

22. *See infra* Part III.

remain for adapting biodiversity governance to be better directed at promoting learning, reducing uncertainty, and adjusting strategies as ecological conditions shift and managers gain information.

Third, the configuration of authority among institutional actors charged with implementing natural resources law remains underexplored and deficient.[23] There has been insufficient attention directed at parsing and adjusting the structure of governance. Unfortunately, authority over natural resources management and regulation has remained largely fragmented into many decentralized, overlapping, and poorly coordinated institutions. Tailored alterations to the allocation of authority over natural resources can leverage key advantages of centralized and/or coordinated institutions while maintaining the largely decentralized, independent, and overlapping character of public biodiversity governance.

The Article proceeds in five parts. Part I briefly describes how addressing biodiversity loss is a particularly complex challenge—part of a super wicked crisis, in light of global anthropogenic climate change.[24] Unfortunately, the wicked problems literature provides only limited help for assessing existing governance or envisioning alternatives more attuned to the problem.

Accordingly, the Article focuses on how conservation laws have been designed in ways that make biodiversity loss impossible to address. It does so by deconstructing public governance—separating out substantive regulatory goals and strategies from its processes and the structural allocation of regulatory authority. The focus is the United States, though other regimes are likely subject to similar deficiencies.[25] Part II considers how, particularly in the context of global anthropogenic climate change, U.S. natural resources governance has lacked the substantive legal adaptive capacity to meaningfully manage biodiversity loss. Part III details the limitations of public biodiversity governance processes. Part IV explores the inadequacy of the existing configuration of authority among the primary public institutions charged with managing ecological resources. Finally, Part V offers a preliminary reconstruction of public biodiversity governance, explaining how the United States might reframe public institutions to better address biodiversity loss.[26]

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23. *See infra* Part IV.

24. *See infra* Part I.

25. *See, e.g.*, Alejandro E. Camacho, *Managing Ecosystem Effects in an Era of Rapid Climate Change*, *in* ELGAR ENCYCLOPEDIA OF ENVIRONMENTAL LAW, VOL. 1: CLIMATE CHANGE LAW 555, 558 (Michael Faure ed., 2016) (describing the limited adaptive capacity of governance in the United States and European Union to manage climate change's ecological effects).

26. *See infra* Part V.

I. THE WICKEDNESS OF BIODIVERSITY LOSS

A. Biodiversity Loss as a Wicked Problem

Biodiversity loss appears to be particularly wicked. The seminal articulation of "wicked problems" offered ten characteristics, though the last is idiosyncratic to the urban planning context: (1) no definitive formulation; (2) no stopping rule; (3) solutions are not true-or-false, but good-or-bad; (4) no immediate and ultimate test of solutions; (5) solutions are "one-shot operations"; (6) innumerable potential solutions; (7) uniqueness; (8) problem is symptomatic of other problem(s); (9) discrepancies in representing, explaining, and thus solving the problem; and (10) planners are responsible for the consequences of their actions.[27] Subsequent scholarship has generalized and distilled these components, though not often in consistent ways.[28] Some added the more selective category of "super wicked problems," for which also "time is running out; those who cause the problem also seek to provide a solution; the central authority needed to address them is weak or non-existent; and irrational discounting occurs that pushes responses into the future."[29] Meanwhile, Professors Ruhl and Salzman categorize "massive" problems based on the attributes of causal sources, causal mechanisms, and cumulative effects.[30]

Analysis of these criteria suggests that biodiversity loss likely qualifies as a wicked, perhaps a super wicked, problem. A number of commenters, albeit with limited explanation, have concluded as such, particularly in conjunction with global anthropogenic climate change.[31] As stated by one scholar,

> [T]hreats to global biodiversity, against the approaching beat of a changing climate[,] . . . have created a set of "wicked problems," that are messy, intractable, subject to multiple

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27. Rittel & Webber, *supra* note 5, at 161–67.

28. One literature synthesis states wicked problems are (1) indefinable, (2) ambiguous and interconnected, (3) temporally challenging, (4) repercussive, (5) doubly hermeneutic, and (6) morally consequential. D. Duckett, D. Feliciano, J. Martin-Ortega & J. Munoz-Rojas, *Tackling Wicked Environmental Problems: The Discourse and Its Influence on Praxis in Scotland*, 154 LANDSCAPE & URB. PLAN. 44, 45 (2016). Others emphasize dimensions of complexity, uncertainty, and divergence. Brian W. Head, *Wicked Problems in Public Policy*, 3 PUB. POL'Y 101, 103 (2008). Several focus on features of cross-disciplinarity and need for collaboration. *See, e.g.*, Sandra A. Waddock, *Educating Holistic Professionals in a World of Wicked Problems*, 2 APPLIED DEVELOPMENTAL SCI. 40, 43 (1998).

29. Kelly Levin, Benjamin Cashore, Steven Bernstein & Graeme Auld, *Overcoming the Tragedy of Super Wicked Problems: Constraining Our Future Selves to Ameliorate Global Climate Change*, 45 POL'Y SCIS. 123, 124 (2012).

30. Ruhl & Salzman, *supra* note 4, at 73.

31. *See, e.g.*, Catherine Allan, *Can Adaptive Management Help Us Embrace the Murray-Darling Basin's Wicked Problems?*, *in* ADAPTIVE AND INTEGRATED WATER MANAGEMENT: COPING

> interpretations, and for which solutions at present are not evident or inscrutable. Dealing with the causes and consequences of biodiversity loss in a changing environment is one such problem.[32]

The relevant classic factors suggest a strong case for global and local biodiversity loss as wicked. Biodiversity, and its consequent loss, is well recognized as a challenging concept to formulate.[33] The causal chains linking different ecosystem components are complex, dynamic, nonlinear, and unpredictable.[34] Promoting biodiversity conservation is a normative proposition.[35] Though there likely are many possible strategies for combatting biodiversity loss, a definitive criterion for demonstrating success is illusive.[36] Both the study and implementation of strategies for reducing biodiversity loss can influence and alter the problem.[37] There are countless possible, contestable social responses for reducing or restoring biodiversity, particularly as influenced by climate change.[38] The particular risk of irreversibility makes biodiversity loss distinctive,[39] and biodiversity loss is certainly symptomatic of deeper problems, including climate change[40] and unsustainable development.[41] Finally, failures to address biodiversity loss are subject to "widely divergent explanations."[42]

WITH COMPLEXITY AND UNCERTAINTY 61, 64 (Claudia Pahl-Wostl, Pavel Kabat & Jörn Möltgen eds., 2008); Ruth DeFries & Harini Nagendra, *Ecosystem Management as a Wicked Problem*, 356 SCIENCE 265, 266 (2017).

32. Kent H. Redford, William Adams & Georgina M. Mace, *Synthetic Biology and Conservation of Nature: Wicked Problems and Wicked Solutions*, PLOS BIOLOGY, vol. 11, Apr. 2013, at 1, 1.

33. *See* Sharman & Mlambo, *supra* note 8, at 275 ("'Biodiversity' is notoriously difficult to define, and the differences are often significant."); Daniel P. Faith, *Biodiversity*, STAN. ENCYC. PHIL. (Jun. 11, 2003), https://plato.stanford.edu/entries/biodiversity/ [https://perma.cc/9N7C-BFJW] (examining the varied and often conflicting ways in which scholars define "biodiversity"); *see also infra* notes 277–287 and accompanying text.

34. DeFries & Nagendra, *supra* note 31, at 257.

35. *See* Paul Roebuck & Paul Phifer, *The Persistence of Positivism in Conservation Biology*, 13 CONSERVATION BIOLOGY 444 (1999) (arguing that biodiversity conservation is rooted primarily in ethics and should reverse the trend of a focus on fact verification and falsification).

36. Sharman & Mlambo, *supra* note 8, at 275.

37. *Id.* at 276.

38. *Id.*; Terry L. Root, Diana Liverman & Chris Newman, *Managing Biodiversity in the Light of Climate Change: Current Biological Effects and Future Impacts*, *in* KEY TOPICS IN CONSERVATION BIOLOGY 85, 100 (David W. Macdonald & Katrina Service eds., 2007).

39. Faith, *supra* note 33.

40. Root et al., *supra* note 38, at 85 ("[P]redicted changes in global and regional climates as a result of increasing atmospheric carbon dioxide have tremendous implications for species and habitat conservation."); ALLISTER SLINGENBERG, LEON BRAAT, HENNY VAN DER WINDT, KOEN RADEMAEKERS, LISA EICHLER & KERRY TURNER, STUDY ON UNDERSTANDING THE CAUSES OF BIODIVERSITY LOSS AND THE POLICY ASSESSMENT FRAMEWORK 54 (2009) ("Biodiversity and climate change are closely inter-linked, and each impacts upon the other . . . .").

41. SLINGENBERG ET AL., *supra* note 40, at 13.

42. Sharman & Mlambo, *supra* note 8, at 276.

In fact, biodiversity loss, particularly as it is fundamentally linked to global climate change, meets the additional criteria of a super wicked problem. Time is of the essence in light of rapid declines, and no single authority is charged with managing the problem.[43] Moreover, the primary perpetrators are those in the best position to address it (and have little incentive to do so).[44]

Similarly, Ruhl and Salzman's framework—considering the causal sources, causal mechanisms, and cumulative effects—suggests biodiversity loss, again linked to climate change, is an especially massive problem.[45] First, the stressors that lead to biodiversity loss—including direct stressors like human development[46] and more indirect ones such as invasive species,[47] habitat fragmentation,[48] and, increasingly, global anthropogenic climate change[49]—are many, diverse, dispersed, and quite variable.[50] Moreover, the causal mechanisms of biodiversity loss occur on multiple governance and geographic scales;[51] are often latent;[52] and can be complex, nonlinear, intertwined, and attenuated.[53] Finally, the many disparate,

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43. Lazarus, *supra* note 6, at 1160.

44. *Id.* at 1160–61.

45. *See* Ruhl & Salzman, *supra* note 4, at 73–79.

46. Alexander Wood, *An Emerging Consensus on Biodiversity Loss*, *in* THE ROOT CAUSES OF BIODIVERSITY LOSS 1, 5 (Alexander Wood, Pamela Stedman-Edwards & Johanna Mang eds., 2000) ("[H]abitat alteration is clearly the predominant cause and is a problem that operates at the local scale."); SLINGENBERG ET AL., *supra* note 40, at 13.

47. Wood, *supra* note 46, at 5; SLINGENBERG ET AL., *supra* note 40, at 56.

48. SLINGENBERG ET AL., *supra* note 40, at 13, 29.

49. *See* Wood, *supra* note 46, at 5; SLINGENBERG ET AL., *supra* note 40, at 54.

50. Sharman & Mlambo, *supra* note 8, at 276.

51. *See, e.g.*, J.A. Puppim de Oliveira, O. Balaban, C.N.H. Doll, R. Moreno-Peñaranda, A. Gasparatos, D. Iossifova & A. Suwa, *Cities and Biodiversity: Perspectives and Governance Challenges for Implementing the Convention on Biological Diversity (CBD) at the City Level*, 144 BIOLOGICAL CONSERVATION 1302, 1303 (2011); Klaus Bosselmann, *Plants and Politics: The International Legal Regime Concerning Biotechnology and Biodiversity*, 7 COLO. J. INT'L ENV'T L. & POL'Y 111, 113–14 (1996); Duckett et al., *supra* note 28, at 44–45.

52. *See* Mikko Kuussaari, Riccardo Bommarco, Risto K. Heikkinen, Aveliina Helm, Jochen Krauss, Regina Lindborg, Erik Öckinger, Meelis Pärtel, Joan Pino, Ferran Rodà, Constantí Stefanescu, Tiit Teder, Martin Zobel & Ingolf Steffan-Dewenter, *Extinction Debt: A Challenge for Biodiversity Conservation*, 24 TRENDS IN ECOLOGY & EVOLUTION 564, 564 (2009) (highlighting "a notable increase in awareness of delayed extinctions, also called extinction debt, as an important factor to consider in biodiversity conservation").

53. *See e.g.*, Justin Kitzes, Eric Berlow, Erin Conlisk, Karlheinz Erb, Katsunori Iha, Neo Martinez, Erica A. Newman, Christoph Plutzar, Adam B. Smith & John Harte, *Consumption-Based Conservation Targeting: Linking Biodiversity Loss to Upstream Demand Through a Global Wildlife Footprint*, 10 CONSERVATION LETTERS 531, 531 (2016) ("[P]roximate causes of biodiversity loss, however, are themselves driven by upstream economic activities."); Chris D. Thomas, Alison Cameron, Rhys E. Green, Michel Bakkenes, Linda J. Beaumont, Yvonne C. Collingham, Barend F.N. Erasmus, Marinez Ferreira de Siqueira, Alan Grainger, Lee Hannah, Lesley Hughes, Brian Huntley, Albert S. van Jaarsveld, Guy F. Midgley, Lera Miles, Miguel A. Ortega-Huerta, A.

incremental, and long-term effects that lead to biodiversity loss can be difficult to identify, measure, and reverse,[54] and occur intermittently and sporadically.[55] In fact, in light of global climate change's pervasive influence on the various causes of biodiversity loss,[56] it is likely part of the most complex archetype of massive problems identified by Ruhl and Salzman—the policy jungle.[57]

B. Managing Wickedness

The literature on wicked problems provides some, albeit incomplete, direction for designing public governance to better manage complex problems such as biodiversity loss. Numerous scholars have developed intricate proposals for addressing wicked problems through facilitated planning and dispute resolution—termed alternatively as an "issue-based information system,"[58] "dialogue mapping,"[59] "problem structuring methods,"[60] "general morphological analysis,"[61] "systems

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Townsend Peterson, Oliver L. Phillips & Stephen E. Williams, *Extinction Risk from Climate Change*, 427 NATURE 145, 147 (2004) (stating that most severe effects on biodiversity will be from interactions between threats to biodiversity, rather than threats like climate change "acting in isolation").

54. *See* SLINGENBERG ET AL., *supra* note 40, at 13 (listing the many factors that can all contribute to biodiversity loss).

55. *Id.* at 56.

56. Thomas et al., *supra* note 53, at 147.

57. Ruhl & Salzman, *supra* note 4, at 88 (defining policy jungles as cumulative effects problems that combine the attributes of feedback, discontinuity, and spaghetti bowl problems).

58. *See, e.g.*, Werner Kunz & Horst W.J. Rittel, *Issues as Elements of Information Systems* 1 (Inst. for Urb. & Reg'l Dev., Univ. of Cal., Berkeley, Working Paper No. 131, 1970), https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.134.1741&rep=rep1&type=pdf [https://perma.cc/K73K-VDMV] (offering an "Issue-Based Information System" (IBIS) to help stakeholders coordinate to manage complex problems).

59. *See, e.g.*, JEFF CONKLIN, DIALOGUE MAPPING: BUILDING SHARED UNDERSTANDING OF WICKED PROBLEMS 19 (2005) (proposing "dialogue mapping," based on IBIS, as a facilitated process for bringing stakeholders together to "generate coherence around wicked problems").

60. *See, e.g.*, Jonathan Rosenhead, *What's the Problem? An Introduction to Problem Structuring Methods*, 26 INTERFACES 117, 119 (1996) (suggesting a group problem-solving process that integrates multiple perspectives, transparency, and relationship building).

61. *See, e.g.*, Tom Ritchey, *Wicked Problems: Modelling Social Messes with Morphological Analysis*, 2 ACTA MORPHOLOGICA GENERALIS 1, 5–6 (2013) (proposing a group-facilitated and iterative "General Morphological Analysis" problem-solving process "attuned to the methodological issues of wicked problems").

thinking" and "agile methodology,"[62] or "mess mapping."[63] Though often short on how they might apply in different contexts, these generalizable frameworks focus on outlining templates for tackling complexity through intricate problem-solving processes. An overlapping literature originating in the ecological sciences has developed and studied how adaptive management and resilience theory can help managers better understand and tackle socio-ecological problems.[64]

Both of these literatures thus largely focus on the procedural aspect of governance, and as important as that component might be, it is not everything. Only a few wicked problems scholars explore institutional or structural mechanisms, and even then they are typically fused with procedural strategies.[65] Similarly, although the more robust adaptive management literature provides a useful framework for assessing and adjusting governance to manage uncertainties in decisionmaking, adaptive management largely emphasizes procedural and, to a much more limited extent, structural features of governance for managing complexity and change.[66] In short, the wicked tag, to date, has provided incomplete guidance for assessing and adjusting governance.

A more comprehensive review of not only the procedural but also the substantive and structural aspects of public governance is needed to get a complete picture of how well governmental institutions have been devised to manage wicked problems. As further detailed in Parts II, III, and IV, the substantive goals and strategies, processes, and structure of public biodiversity governance are each not well designed to either tackle biodiversity loss or manage change. Unfortunately, this

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62. *See, e.g.*, Euphemia Wong, *What Is a Wicked Problem and How Can You Solve It?*, INTERACTION DESIGN FOUND., https://www.interaction-design.org/literature/article/wicked-problems-5-steps-to-help-you-tackle-wicked-problems-by-combining-systems-thinking-with-agile-methodology (last visited Nov. 2, 2020) [https://perma.cc/Y9MV-K2LW] (proposing "systems thinking" process as "perfect for wicked problems" when paired with "agile methodology," an "iterative approach" that "helps to improve solutions through collaboration").

63. *See, e.g.*, ROBERT E. HORN & ROBERT P. WEBER, STRATEGY KINETICS, NEW TOOLS FOR RESOLVING WICKED PROBLEMS: MESS MAPPING AND RESOLUTION MAPPING PROCESSES 5 (2007), https://www.strategykinetics.com//New_Tools_For_Resolving_Wicked_Problems.pdf [https://perma.cc/8VA9-YDBM] (recommending "mess mapping" for problem solving "so that stakeholders arrive at a common framework for understanding these problems").

64. *See, e.g.*, C.J.A.M. Termeer, A. Dewulf, S.I. Karlsson-Vinkhuyzen, M. Vink & M. van Vliet, *Coping with the Wicked Problem of Climate Adaptation Across Scales: The Five R Governance Capabilities*, 154 LANDSCAPE & URB. PLAN. 11, 14 (2016) (describing resilience, among other features, as crucial to governance of wicked problems). *See infra* notes 183–190 and accompanying text.

65. *See infra* notes 205–208 and accompanying text.

66. *See, e.g.*, Robin Kundis Craig & J.B. Ruhl, *Designing Administrative Law for Adaptive Management*, 67 VAND. L. REV. 1, 18–27 (2014) (describing adaptive management and strategies for better accommodating it in regulatory processes).

review reveals that these limitations are particularly evident and problematic in light of global anthropogenic climate change.[67]

II. THE GOALS AND TOOLS OF PUBLIC BIODIVERSITY GOVERNANCE

Though the wicked problems literature has not explored how substantive governance might be reshaped to better manage wickedness, natural resources law has certainly instituted a range of substantive strategies aimed at reducing certain causes of biodiversity loss. Statutes at various governmental scales have conventionally focused on regulating prospective development, reserving lands for various purposes, or restricting invasive species. While these largely preservationist strategies may have always been imperfect proxies for biodiversity conservation, they are particularly inadequate for curtailing biodiversity loss in the context of global climate change. Even more flexible passive management strategies—such as public lands focused on maximizing yield, wildlife corridors, and private conservation incentives—are only partly tethered to promoting biodiversity in light of large-scale shifts in ecological conditions. As a result, natural resources law has limited substantive legal adaptive capacity, and those goals and strategies that are more accommodating of change are not directed primarily at maximizing prospective biodiversity conservation.

A. Regulate Development Causing Future Biodiversity Loss

The most direct strategy employed today for promoting species conservation in the United States may be the regulation of private and public development.[68] This strategy has primarily focused on promoting a particular aspect of biodiversity—namely, preventing species extinction and, to a lesser extent, avoiding species from being in danger of going extinct.[69] The chief strategy for achieving this end has been to

67. *See* Daniel Schramm & Akiva Fishman, *Legal Frameworks for Adaptive Natural Resource Management in a Changing Climate*, 22 GEO. INT'L ENV'T L. REV. 491, 497 (2010) (arguing that weaknesses in the ability of legal regimes to respond to climate change "stem from both rigidity in the administrative procedures of the law and the absence of mandates to achieve long-term tangible objectives").

68. *See, e.g.*, ZYGMUNT J.B. PLATER, ROBERT H. ABRAMS, ROBERT L. GRAHAM, LISA HEINZERLING, DAVID A. WIRTH & NOAH D. HALL, ENVIRONMENTAL LAW AND POLICY: NATURE, LAW, AND SOCIETY 422–23 (5th ed. 2016).

69. *See, e.g.*, 16 U.S.C. § 1531(b) (aiming "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species").

prevent or minimize affirmative, relatively direct human actions that would harm designated species.

The Endangered Species Act ("ESA") is the clearest example of this strategy. Congress enacted the ESA to promote "better safeguarding, for the benefit of all citizens, the Nation's heritage in fish, wildlife, and plants,"[70] recognizing that many vulnerable species are of "esthetic, ecological, educational, historical, recreational, and scientific value."[71] In addition, the ESA declares as a primary purpose not only the protection of endangered species but also the conservation of the ecosystems upon which such species depend.[72]

However, the key regulatory hooks of the ESA—sections 7, 9, and 10—are all reactive, each placing restrictions on human activity that affirmatively harms species listed as threatened or endangered.[73] Section 7 prohibits any federal action[74] that would "jeopardize the continued existence"[75] of any listed species or result in the modification of its "critical habitat."[76] Section 9 strictly prohibits the "take" of any endangered species by any person, public or private.[77] The statute broadly extends the stringent ban on taking to include "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct,"[78] and subsequent judicial opinions have upheld expansive regulatory interpretations of this language to include the substantial modification of habitat.[79] Each of these restrictions

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70. *Id.* § 1531(a)(5).

71. *Id.* § 1531(a)(3).

72. *See id.* § 1531(b); *see also* Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 699–700 (1995) (acknowledging that the ESA serves to protect vulnerable ecosystems, with listed species functioning as an indicator that the underlying ecosystem is faltering).

73. Listing is based on an assessment of the risk of extinction that relies on "the best scientific and commercial data available." 16 U.S.C. § 1533(b)(1)(A).

74. Action includes any activity "authorized, funded, or carried out, in whole or in part, by Federal agencies." 50 C.F.R. § 402.02 (2019).

75. 16 U.S.C. § 1536(a). *See also* Tenn. Valley Auth. v. Hill, 437 U.S. 153, 184 (1978) (finding jeopardy determination must be made strictly without regard to costs and benefits of the proposed agency action).

76. 16 U.S.C. § 1533(b)(2).

77. *Id.* § 1538(a)(1). For threatened species, the take prohibition is not automatic; the U.S. Fish and Wildlife Service may apply the ban at its discretion, see *id.* § 1533(d), which it has done in most cases. *See* TIMOTHY BEATLEY, HABITAT CONSERVATION PLANNING: ENDANGERED SPECIES AND URBAN GROWTH 17 (1994).

78. 16 U.S.C. § 1532(19).

79. *See* Palila v. Haw. Dep't of Land & Nat. Res., 639 F.2d 495, 497 (9th Cir. 1981) (defining "harm" "to include activity that results in significant environmental modification or degradation of the endangered animal's habitat"); Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 965 (1995) (finding that the secretary of the interior acted reasonably in "promulgat[ing] a regulation that defines the [ESA's] prohibition on takings to include 'significant habitat modification or degradation where it actually kills or injures wildlife' ").

focuses primarily on limiting relatively direct human actions that cause biodiversity loss and secondarily on guarding fragmented habitat, rather than fostering species recovery, comprehensive ecosystem conservation, or other measures of biodiversity.[80]

Even section 10, often lauded as a way to promote more comprehensive constructions of ecosystem conservation, focuses on minimizing direct harm to listed species. Added later to the ESA to allow the U.S. Fish and Wildlife Service ("FWS") and the National Marine Fisheries Service ("NMFS")[81]—collectively referred to here as "the Services" or individually as "the Service"—to issue "incidental take" permits, section 10 allows private and public permittees to harm or even destroy members of a protected species if incidental[82] and undertaken in conjunction with an approved habitat conservation plan ("HCP").[83] Notably, this change to the ESA expressly allows biodiversity loss so long as (1) the harm's impacts are mitigated "to the maximum extent practicable," (2) the applicant provides "adequate" funding, (3) the likelihood of survival and recovery of the species is not "appreciably" reduced, and (4) the plan includes any other "necessary or appropriate" measures.[84]

A number of permittees have agreed to design their HCPs not merely to restrict development but also to consider a more expansive biodiversity focus, including managing indirect stressors such as invasive species or habitat fragmentation.[85] Moreover, some HCPs have focused on protecting not only specifically listed species but also other vulnerable species, habitat, or ecological communities.[86]

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80. *See* LAURA HOOD, FRAYED SAFETY NETS: CONSERVATION PLANNING UNDER THE ENDANGERED SPECIES ACT 3 (1998); Craig W. Thomas, *Habitat Conservation Planning: Certainly Empowered, Somewhat Deliberative, Questionably Democratic*, 29 POL. & SOC'Y 105, 107 (2001).

81. The ESA is primarily administered by the secretary of the interior through the FWS for land and freshwater species and by the secretary of commerce through the National Marine Fisheries Service for marine species. *See* 16 U.S.C. § 1532(15) (defining "secretary"); *id.* § 1533(a)(2); 50 C.F.R. § 424.01 (2019) (FWS-NMFS joint regulations).

82. An "incidental take" is broadly defined as any taking "that result[s] from, but [is] not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant." 50 C.F.R. § 402.02.

83. The Services may issue a permit to private or non-federal public actors that authorize the incidental take of a listed species in conjunction with an approved habitat conservation plan ("HCP"). 16 U.S.C. § 1539(a). Federal agencies and federal permittees can also circumvent the section 9 prohibitions if the Service issues an incidental take statement ("ITS") through the section 7 interagency consultation process. *See* 16 U.S.C. §§ 1536(b)(4), 1539(a)(1)(B).

84. 16 U.S.C. § 1539(a)(2).

85. Alejandro E. Camacho, *Can Regulation Evolve? Lessons from a Study in Maladaptive Management*, 55 UCLA L. REV. 293, 303, 305 (2007).

86. *See* William Vogel & Lorin Hicks, *Multi-species HCPs: Experiments with the Ecosystem Approach*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/endangered/what-we-do/bulletins/multi-species-hcp.html (last updated Aug. 28, 2012) [https://perma.cc/45HP-VDU2] (describing

Nonetheless, even these plans still remain directed at promoting a static conception of preexisting biotic communities or assemblages and are not tethered to conceptions of ecological health that internalize ecological change.[87] In fact, the ESA is focused on conservation that is largely (though not exclusively) directed at maintaining biodiversity where it historically was and resisting change.[88] Moreover, the chief U.S. legal regime for promoting biodiversity conservation is not focused on actively addressing many of the conventional cumulative stressors leading to biodiversity loss. Indeed, many have recognized the ESA's emphasis on preventing development has had limited success in reversing most of the stressors causing biodiversity loss.[89]

Notably, ESA section 4 does generally require the Services to develop and implement recovery plans for the conservation and survival of listed species.[90] Plans include a range of strategies for recovering and ultimately delisting endangered species, including "restoring and acquiring habitat, removing invasive species, conducting surveys, monitoring individual populations, and breeding species in captivity to release them into their historic range."[91] Critically, however, recovery plans are unenforceable guidance, so that "no agency or entity is required by the ESA to implement actions in a recovery plan."[92] Moreover, most plans lack sufficient funding for carrying out planned recovery measures.[93] Finally, by design, adopted recovery plans focus on accomplishing recovery of a particular listed species, not the broader fitness of particular ecosystems or ecological functions. Though recovery of listed species would improve or at least maintain species biodiversity, even full implementation of a recovery plan (and thus recovery of a listed species) may not stem other significant biodiversity concerns (such as the health of non-listed species or ecological functions not directly tethered to the listed species).

HCPs used to restore aquatic habitats, protect caves, and accomplish other objectives beyond solely protecting listed species).

87. Alejandro E. Camacho, *Going the Way of the Dodo: De-extinction, Dualisms, and Reframing Conservation*, 92 WASH. U. L. REV. 849, 878 (2015).

88. *Id.*

89. Camacho, *supra* note 85, at 346 & n.309.

90. 16 U.S.C. § 1539(a).

91. *Endangered Species Recovery Program*, U.S. FISH & WILDLIFE SERV. (June 2011), https://www.fws.gov/endangered/esa-library/pdf/recovery.pdf [https://perma.cc/2PYX-SD6V].

92. *Recovery: Overview*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/endangered/what-we-do/recovery-overview.html (last updated June 10, 2020) [https://perma.cc/B3HT-LQVD].

93. Alejandro E. Camacho, Michael Robinson-Dorn, Asena Cansu Yildiz & Tara Teegarden, *Assessing State Laws and Resources for Endangered Species Protection*, 47 ENV'T L. REP. NEWS & ANALYSIS 10837, 10842–43 (2017).

This is tied to another limitation of the ESA: it is primarily focused on goals other than ecological health or productivity. As I have argued elsewhere, the ESA's conception of biodiversity is largely linked to *historical preservation*—protecting or restoring species where they are or used to be—and secondarily on *wildness preservation*, or limiting human intervention in ecological processes.[94] Even the ESA is reticent to allow interventions designed to promote future ecological function or health, with the few more active strategies used (such as captive breeding and translocations) focused primarily on restoration and not on advancing ecological health in light of anticipated climatic conditions.[95]

B. Reserving, Preserving, and/or Restoring Land

The dominant public biodiversity conservation strategy in the United States, and even globally, may not be regulation of development but rather reserved lands—setting aside public lands and managing them to promote conservation.[96] About twenty-eight percent of all land in the United States is federally owned and managed,[97] with additional state lands augmenting this number. Most of this land is set aside for a range of natural resource purposes that historically have been understood as, at least in part, promoting the conservation of biodiversity.[98] But it is increasingly clear that these core management goals are at best imperfect surrogates for, and

94. Camacho, *supra* note 87, at 878–79. The term "historical preservation," used here to describe ecological preservation or restoration to a historical baseline, is related to but distinguishable from "historic preservation," employed in other contexts (such as certain programs of the National Park Service) focused on the built environment and resources primarily of significance to American history or prehistory. *See, e.g.*, 54 U.S.C. § 302101 (establishing the National Register of Historic Places).

95. Camacho, *supra* note 87, at 878–79.

96. *See, e.g.*, Terry L. Erwin, *An Evolutionary Basis for Conservation Strategies*, 253 SCIENCE 750, 750 (1991) ("National parks, wildlife refuges, biosphere reserves, military reserves, Indian reservations, and other forms of legally protected areas have been established for aesthetic, political, or practical purposes in the last 150 years."); C.R. Margules & R.L. Pressey, *Systematic Conservation Planning*, 405 NATURE 243, 243 (2000) (describing the ancient human practice of preserving lands and the basic role of modern reserves); Frank J. Rahel, Britta Bierwagen & Yoshinori Taniguchi, *Managing Aquatic Species of Conservation Concern in the Face of Climate Change and Invasive* Species, 22 CONSERVATION BIOLOGY 551, 552 (2008) (discussing how reserves "are the mainstay of current conservation efforts").

97. ROSS W. GORTE, CAROL HARDY VINCENT, LAURA A. HANSON & MARC R. ROSENBLUM, CONG. RSCH. SERV., R42346, FEDERAL LAND OWNERSHIP: OVERVIEW AND DATA 3 (2012), https://cdn.cnsnews.com/documents/FEDERAL%20OWNERSHIP%20OF%20LAND-CRS-2012.pdf [https://perma.cc/2BXX-6RKQ].

98. The most significant exception is the approximately nineteen million acres of land managed by the Department of Defense. *Id.* at 1, 13.

perhaps even antagonistic to, long-term ecological health and biodiversity conservation.

Federal public lands have been set aside for a range of natural resource uses and goals. One hundred and ninety-three million acres of national forests are managed by the United States Forest Service ("USFS") pursuant to the National Forest Management Act.[99] Nearly 248 million acres of Bureau of Land Management ("BLM") land is managed under the Federal Land Policy and Management Act of 1976.[100] The national park system is managed by the National Park Service ("NPS"), which most prominently includes over fifty-two million acres of designated national parks[101] managed under the National Park Service Organic Act.[102] And approximately eighty-nine million acres of terrestrial federal wildlife refuges are administered by the FWS pursuant to the National Wildlife Refuge System Improvement Act ("NWRSIA").[103] In addition, 111 million acres of the above-listed federal lands are specially designated by Congress to be federal wilderness[104] and subject to an additional overlay of regulation pursuant to the Wilderness Act of 1964.[105]

To varying degrees, public land laws each anticipate promoting biodiversity, but only indirectly or secondarily through other conservation objectives. National parks, for instance, primarily emphasize historical preservation—preserving or even restoring preexisting species or assemblages where they were or are, typically tethered to a baseline of pre-European settlement.[106] This objective has surely helped preserve substantial biodiversity as compared to analogous lands subject to human disturbance such as urban, suburban, or agricultural development. Yet minimizing or reversing biodiversity loss is not the primary focus; rather, it is on preserving

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99. National Forest Management Act, 16 U.S.C. §§ 1600-1687. The Forest Service's Organic Administration Act of 1897, 16 U.S.C. § 475, created the USFS, and the Multiple-Use Sustained-Yield Act of 1960, 16 U.S.C. §§ 528-531, broadened the use objectives of the national forests to include "outdoor recreation, range, timber, watershed, and wildlife and fish purposes." *Id.* § 528.

100. Federal Land Policy and Management Act of 1976, 43 U.S.C. §§ 1701-1785.

101. U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2012, at 772 (2012), https://www2.census.gov/library/publications/2011/compendia/statab/131ed/2012-statab.pdf [https://perma.cc/4PKR-7YEB].

102. National Park Service Organic Act of 1916, 16 U.S.C. § 1 (repealed 2014).

103. National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. §§ 668dd, 668ee.

104. *See The Beginnings of the National Wilderness Preservation System*, WILDERNESS CONNECT, https://wilderness.net/learn-about-wilderness/fast-facts/default.php (last updated Dec. 8, 2016) [https://perma.cc/7V8K-4XLL] (describing the growth of the National Wilderness Preservation System ("NWPS") since its beginning in 1964).

105. Wilderness Act of 1964, 16 U.S.C. §§ 1131-1336.

106. Alejandro E. Camacho, *Assisted Migration: Redefining Nature and Natural Resource Law Under Climate Change*, 27 YALE J. ON REGUL. 171, 218 (2010).

preexisting conditions. In other words, maintaining historical fidelity may not necessarily promote biodiversity.

A complement or corollary to historical preservation is ecological restoration—or assisted recovery—of an ecosystem previously damaged, degraded, or destroyed by human action.[107] It draws extensively on scientific tools provided by the ecological science subdiscipline of restoration ecology.[108] This approach customarily seeks to restore disturbed ecosystems to some past baseline,[109] though the particular target baseline may be contentious and value-laden,[110] and some formulations seek to capaciously conceptualize restoration to advance other conservation values such as ecological integrity.[111] The ongoing Florida Everglades restoration, sanctioned by Congress in 1996,[112] is a prominent application and includes goals such as restoration of historic hydrology, improvement of local water quality, protection of existing natural habitats, and prevention, eradication, containment, and management of incursions of invasive species.[113] As with historical preservation, the focus in the Everglades project is on restoration as a surrogate for reversing biodiversity loss, but the stated

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107. *See, e.g.*, *What is Ecological Restoration?*, SOC'Y FOR ECOLOGICAL RESTORATION, https://www.ser-rrc.org/what-is-ecological-restoration/ (last visited Sept. 26, 2020) [https://perma.cc/6MGJ-K7CV] ("Ecological restoration seeks to initiate or accelerate ecosystem recovery following damage, degradation, or destruction.").

108. *See generally* Eric Higgs, *The Two-Culture Problem: Ecological Restoration and the Integration of Knowledge*, 13 RESTORATION ECOLOGY 159 (2005) (recommending a broader approach to restoration and recognizing that the practice of restoration has begun to narrowly focus on the science of restoration ecology).

109. *See, e.g.*, Richard J. Hobbs, *Restoration Ecology: The Challenge of Social Values and Expectations*, 2 FRONTIERS ECOLOGY & ENV'T 43, 43 (2004) ("[T]he objective of restoration is often to return the system to some previous state, often one that existed prior to human influence, such as pre-Columbian North America.").

110. Baseline is inevitably a value choice and may be contentious. *See id.* at 43 (discussing how choice plays a contentious role in restoration and the values that are considered when determining restoration goals); Robert T. Lackey, *Societal Values and the Proper Role of Restoration Ecologists*, 2 FRONTIERS ECOLOGY & ENV'T 45, 45 (2004) (describing how society's goals and values are often fragmented, and in turn, "technocrats have an understandable impulse to insert what they think is, or should be, the appropriate goal").

111. *See* Young D. Choi, *Restoration Ecology to the Future: A Call for New Paradigm*, 15 RESTORATION ECOLOGY 351, 351 (2007) (recommending that restoration no longer focus on returning ecosystems to a certain point in the past and instead focus on the future).

112. U.S. Dep't of the Interior, *Office of Everglades Restoration Initiatives*, EVERGLADESRESTORATION.GOV, https://www.evergladesrestoration.gov/oeri/ (last visited Sept. 26, 2020) [https://perma.cc/4B3F-TD64].

113. *See Everglades Restoration Goals*, NAT'L PARK SERV., https://nps.maps.arcgis.com/apps/MapSeries/index.html?appid=e5fd5d9df4944b5ab10a727227aef5fe (last visited Aug. 13, 2020) [https://perma.cc/4DKT-S3ZX] (providing details on eight "subgoals" for Everglades restoration).

goal is historical fidelity, rather than biodiversity directly.[114] Similarly, areas designated as federal wilderness emphasize wildness or "natural" preservation, or the minimization of direct human intervention.[115] Though this goal may historically have helped reduce direct human interferences that could result in biodiversity loss, it too is an imperfect surrogate for biodiversity—particularly for causes of biodiversity loss that are much more indirect.[116]

Other lands managed by the USFS and BLM focus on maintaining multiple uses.[117] More recent adjustments of multiple-use objectives for these lands do emphasize sustainability, which is described as maintenance of ecological function or integrity under at least some interpretations.[118] But promoting any conception of long-term biodiversity conservation has historically been far from the first priority of either agency.[119] These lands have primarily been driven by

114. *See id.* Specifically, some goals driven by historical fidelity include restoring nine thousand square miles of lost habitat and returning the region to its original hydrology and waterflow. *See id.*

115. Camacho, *supra* note 87, at 882.

116. *See Legal Adaptive Capacity*, *supra* note 19, at 792 ("This focus on promoting historical fidelity provides limited substantive legal adaptive capacity for NPS managers to engage in proactive adaptation measures. The tension between fostering active climate change adaptation strategies that seek to advance future ecological health and the NPS's fundamentally historical preservation goals is obvious.").

117. Both the National Forest Management Act, 16 U.S.C. § 1604(e)(1), and the Federal Land Policy and Management Act, 43 U.S.C. § 1701(a)(7), require that their respective lands be managed for multiple uses.

118. *See* Lia Helena Monteiro de Lima Demange, *The Principle of Resilience*, 30 PACE ENV'T L. REV. 695, 808 (2013) (defining ecological resilience as the human's duty to not impair ecological maintenance by overusing or depleting resources); Aphrodite Smagadi, *Analysis of the Objectives of the Convention on Biological Diversity: Their Interrelation and Implementation Guidance for Access and Benefit Sharing*, 31 COLUM. J. ENV'T L. 243, 263 (2006) (discussing the socioeconomic paradigm related to development, sustainability, and ethics, and how the maintenance of ecological integrity falls within this paradigm); Susan L. Smith, *Ecologically Sustainable Development: Integrating Economics, Ecology, and Law*, 31 WILLAMETTE L. REV. 261, 280 (1995) (listing the goals of the International Union for Conservation of Nature and Natural Resources' 1996 Conference on Conservation and Development).

119. Holly Doremus, *Science Plays Defense: Natural Resource Management in the Bush Administration*, 32 ECOLOGY L.Q. 249, 282 (2005) (describing the USFS and the BLM as agencies "whose history and culture puts furthering the interests of extractive industries and local communities first").

consumptive uses, such as timber harvesting,[120] grazing,[121] and mineral development,[122] and not long-term ecological health.

The National Wildlife Refuge System ("National Refuges") is in some sense a hybrid of preservation and sustainable-use goals. The NWRSIA[123] alone does not necessarily restrict management of National Refuges to preserving historical ecological conditions, directing the FWS to "ensure that the biological integrity, diversity, and environmental health of the System are maintained."[124] As such, it offers the FWS "some ability to manage wildlife refuges in ways that allow modification of ecological constituents over time."[125] The FWS's implementing regulations and policies,[126] however, strongly stress "maintaining current environmental conditions or restoring species and habitats to some desired former condition."[127] As such, the FWS allows

120. *See, e.g.*, Steven A. Daugherty, *The Unfulfilled Promise of an End to Timber Dominance on the Tongass: Forest Service Implementation of the Tongass Timber Reform Act*, 24 ENV'T L. 1573, 1585 n.67 (1994) ("[T]he Forest Service, after years of regulating and cooperating with the timber industry in Alaska, will attempt to protect the interests of the timber industry in any situation in which it perceives ambiguity as to the requirements imposed upon it."); *see also* Sierra Club v. Morton, 405 U.S. 727, 748 (1972) (Douglas, J., dissenting) (stating that the Forest Service "has been notorious for its alignment with lumber companies, although its mandate from Congress directs it to consider the various aspects of multiple use in its supervision of the national forests").

121. *See, e.g.*, Debra L. Donahue, *Western Grazing: The Capture of Grass, Ground, and Government*, 35 ENV'T L. 721, 727–29 (2005) (exploring reasons for ranchers' domination of BLM resource management policies).

122. *See* Kelly Nolen, *Residents at Risk: Wildlife and the Bureau of Land Management's Planning Process*, 26 ENV'T L. 771, 776 (1996) (describing why the BLM has given greater weight to the interests of the grazing and mining industries); Harold J. Krent & Nicholas S. Zeppos, *Monitoring Governmental Disposition of Assets: Fashioning Regulatory Substitutes for Market Controls*, 52 VAND. L. REV. 1705, 1719–20 (1999) (discussing government's tendency to give away mineral rights and collect royalties on mining that effectively raise government revenues).

123. National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. §§ 668dd-6668ee.

124. *Id.* § 668dd(a)(4)(B).

125. *Legal Adaptive Capacity*, *supra* note 19, at 776–77.

126. *See* U.S. FISH & WILDLIFE SERV., 601 FW 3, BIOLOGICAL INTEGRITY, DIVERSITY, AND ENVIRONMENTAL HEALTH (2006), https://www.fws.gov/policy/601fw3.pdf [https://perma.cc/RNF6-JECF] (defining "biological integrity" as "[b]iotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities"); *id.* (defining "historic conditions" as "[c]omposition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human related changes to the landscape").

127. U.S. GOV'T ACCOUNTABILITY OFF., GAO-13-253, CLIMATE CHANGE: VARIOUS ADAPTATION EFFORTS ARE UNDER WAY AT KEY NATURAL RESOURCES MANAGEMENT AGENCIES 19 (2013), https://www.gao.gov/assets/660/654991.pdf [https://perma.cc/UG69-ZF8Q]; *see also* J.B. Ruhl & James Salzman, *Gaming the Past: The Theory and Practice of Historic Baselines in the Administrative State*, 64 VAND. L. REV. 1, 18 (2011) ("[T]he FWS strives to manage the nation's wildlife refuges toward a baseline of 'historic conditions.' ").

the introduction of non-native species, but only rarely.[128] Again, this limitation is consistent primarily with an interest in promoting historical preservation, rather than maximizing prospective biodiversity.

C. Invasive Species and Other Wildlife Management Laws

To varying extents, other wildlife management laws at least indirectly target reducing biodiversity loss from human activity. In particular, a broad range of international, federal, and state invasive species laws seek to reduce the movement of species outside their native range. They typically prohibit, restrict, and/or manage the movement of plants and animals into, out of, or within a jurisdiction. These laws often institute a permitting process for the importation[129] and/or release[130] of certain species, with some regimes developing lists of prohibited species[131] while others elect to generate lists of species not requiring permits.[132] These laws in part have focused on preventing or mitigating the introduction and/or dispersal of certain (typically non-native) species that outcompete native species.[133]

Of course, many of these laws have not been particularly successful at stemming biodiversity loss from the proliferation of invasive species.[134] Undoubtedly, underenforcement is a key part of this

128. *See Legal Adaptive Capacity*, *supra* note 19, at 779–80 ("FWS regulations implementing the ESA make clear that nonnative introduction is supposed to be very rare . . . .").

129. *See, e.g.*, ALASKA STAT. § 16.05.921 (2020) (prohibiting the import of venomous reptiles and insects without a permit); ARIZ. REV. STAT. ANN. § 17-306 (2020) (prohibiting the import of live wildlife without authorization); IOWA CODE ANN. § 481A.47 (West 2020) (prohibiting the import of fish and game without a permit).

130. *See, e.g.*, ARIZ. REV. STAT. ANN. § 17-306 (prohibiting the release of live wildlife without authorization); CAL. FISH & GAME CODE § 3515 (West 2020) (requiring approval to release nonresident game birds); N.C. GEN. STAT. § 113-292 (2020) (prohibiting the release of exotic species of wild animals).

131. *See, e.g.*, ALA. ADMIN. CODE r. 220-2-.26 (2020) (providing list of prohibited species); GA. CODE ANN. §§ 27-5-4, 27-5-5 (2020) (providing list of species for which a license or permit is required); 3 PA. CONS. STAT. § 4219(a) (2020) (providing that "[t]he commission shall determine which species of fish are allowed to be propagated in each watershed").

132. *See, e.g.*, ILL. ADMIN. CODE tit. 17, §§ 870.10(a)-870.10(b) (2020) (establishing the "Acquatic Life Approved Species List," which "is comprised of specific species of aquatic life, within the categories of fish, crustaceans, gastropods, mollusks and plants").

133. *See, e.g.*, National Invasive Species Act of 1996, 16 U.S.C. § 4701 (declaring the legislative purpose of preventing "unintentional introduction and dispersal of nonindigenous species into the waters of the United States").

134. *See* Clinton N. Jenkins, Kyle S. Van Houtan, Stuart L. Pimm & Joseph O. Sexton, *US Protected Lands Mismatch Biodiversity Priorities*, 112 PROC. NAT'L ACAD. SCIS. 5081 (2015) (asserting that the United States largely fails to protect biodiversity).

lack of success.[135] Nonetheless, a core problem with many of these laws is that they are not focused on promoting long-term ecological health.

Like some public land laws, many of these laws are almost reflexively directed at historical preservation—resisting the movement of any species not native to an area, without considering whether that movement aids or detracts from ecological health.[136] Relatedly, some provisions maintain that a native species cannot be invasive (and thus restricted), even if the species reduces biodiversity.[137]

Other invasive species provisions are focused more on natural preservation—preventing direct human introductions of species.[138] Intentional movement, whether or not beneficial for ecological health, is treated with skepticism, if not hostility.[139] In contrast, under some such provisions, "natural" migration of a species is deemed acceptable, whether or not such movement reduces ecological health.[140]

Contrast these laws with the lack of conservation restrictions on the introduction or movement of certain species that are very common, often non-native, and that, by most accounts, have had significant effects on biodiversity. Broad swaths of human-disturbed lands integrate livestock and monoculture crops[141] (including cattle and wheat that are non-native to the United States[142]) that have significantly narrowed the nation's biomass into a few categories. This reduction in diversity has largely remained untouched by invasive

135. *See* Camacho et al., *supra* note 93 (analyzing state endangered species laws and concluding that most state regimes are inadequate).

136. *See* Camacho, *supra* note 87, at 870–71 (arguing that U.S. species re-introduction laws largely focus on rigid classifications rather than ecological health).

137. *See e.g.*, Exec. Order No. 13,751, 81 Fed. Reg. 88,609, 88,610 (Dec. 8, 2016) (requiring a species to be non-native to qualify as an "invasive species").

138. *See, e.g.*, ALA. ADMIN. CODE r. 220-2-.26 (focusing on prohibiting human introductions of listed species); ILL. ADMIN. CODE tit. 17, §§ 870.10(a)-870.10(b) (proscribing human importation or possession of non-approved species); Lacey Act, 16 U.S.C. §§ 3371-3378 (making it unlawful to trade illegally acquired fish or wildlife); Plant Protection Act, 7 U.S.C. §§ 7701-7702, 7711-7721, 7731-7736, 7751-7761, 7771-7772, 7781-7786 (providing for the promulgation of regulations aimed at preventing the "spread of plant pests or noxious weeds").

139. *See* Camacho, *supra* note 106, at 176 (describing opposition to intentional movement as a strategy for responding to climate change).

140. *See, e.g.*, NAT'L PARK SERV., MANAGEMENT POLICIES § 4.4.4.1 (2006), https://www.nps.gov/policy/MP_2006.pdf [https://perma.cc/5HSD-RL7P].

141. *See Census of Agriculture Highlights: Farms and Farmland*, U.S. DEP'T OF AGRIC. (Aug. 2019), https://www.nass.usda.gov/Publications/Highlights/2019/2017Census_Farms_Farmland.pdf [https://perma.cc/4SJ2-NVEA] (noting that as of 2017, the United States had more than nine hundred million acres of farmland across approximately two million farms).

142. *See* François Balfourier, Sophie Bouchet, Sandra Robert, Romain De Oliveira, Hélène Rimbert, Jonathan Kitt, Frédéric Choulet, International Wheat Genome Sequencing Consortium, BreedWheat Consortium & Etienne Pau, *Worldwide Phylogeography and History of Wheat Genetic Diversity*, SCI. ADVANCES, May 2019, at 1, 1 (describing the arrival of wheat in North America); G.A. Bowling, *The Introduction of Cattle into Colonial North America*, 25 J. DAIRY SCI. 129 (1942).

species laws, and in fact has received (and continues to receive) significant public subsidy.[143]

D. Corridors and Private Incentives

The dominant strategies for preventing further biodiversity loss have been reserving certain lands, limiting development that further harms endangered species, and curbing the introduction and movement of invasive species. There have, however, been a number of other attempts to build conservation strategies. These often have been more focused on reducing some of the indirect stressors that lead to biodiversity loss.

Particularly notable have been the proliferating efforts to promote more comprehensive assessments of ecological conservation, such as *ecosystem-based* and *landscape-level planning*.[144] Rather than focusing on a particular species, these approaches seek to manage ecological phenomena as a network, either at the ecosystem or broader landscape scale.[145] The ESA in fact has been supplemented and

143. *See* Dan Charles, *Farmers Got Billions from Taxpayers in 2019, and Hardly Anyone Objected*, NPR: THE SALT (Dec. 31, 2019, 4:13 PM ET), https://www.npr.org/sections/thesalt/2019/12/31/790261705/farmers-got-billions-from-taxpayers-in-2019-and-hardly-anyone-objected [https://perma.cc/YL38-YTKB] (detailing significant farm subsidies in the Unites States). At more provincial and international scales, governments have relied on other wildlife management laws that primarily seek to maintain the productivity of particular desired (usually game) species. *See, e.g.*, Julie Lurman Joly, *National Wildlife Refuges and Intensive Management in Alaska: Another Case for Preemption*, 27 ALASKA L. REV. 27, 29 (2010):

> Alaska's fish and wildlife management program, like most state wildlife programs, is geared toward providing hunting opportunities . . . . The intention of the program is to maintain a "sustained yield," which the statute defines as "the achievement and maintenance in perpetuity of the ability to support a high level of human harvest of game, subject to preferences among beneficial uses, on an annual or periodic basis.";

CONG. RSCH. SERV., R45615, INTERNATIONAL TROPHY HUNTING 10–11 (2019), https://crsreports.congress.gov/product/pdf/R/R45615 [https://perma.cc/48Q3-4HTJ] (examining various international, regional, and national wildlife laws, including those that encourage game hunting as part of a species protection program). Though these laws may have helped sustain ecological resources, they are not part of a coherent plan for promoting long-term ecological conservation and may actually be deemed to harm biodiversity. *See, e.g.*, Palila v. Haw. Dep't of Land & Nat. Res., 649 F. Supp. 1070, 1082 (D. Haw. 1986) (concluding that the Hawaii wildlife agency's sport-hunting program had harmed vital endangered species habitat biodiversity and violated the ESA).

144. *See* John Kostyack, Joshua J. Lawler, Dale D. Goble, Julian D. Olden & J. Michael Scott, *Beyond Reserves and Corridors: Policy Solutions to Facilitate the Movement of Plants and Animals in a Changing Climate*, 61 BIOSCIENCE 713 (2011) (introducing policy options to prevent climate-induced extinctions).

145. *See, e.g.*, Norman L. Christensen, Ann M. Bartuska, James H. Brown, Stephen Carpenter, Carla D'Antonio, Rober Francis, Jerry F. Franklin, James A. MacMahon, Reed F. Noss, David J. Parsons, Charles H. Peterson, Monica G. Turner & Robert G. Woodmansee, *The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management*,

reworked to integrate consideration of ecosystem-based and landscape-level management through initiatives such as the HCP program and recovery planning.[146]

Relatedly, some management strategies have sought to foster ecological connectivity between governing jurisdictions as well as lands. This has included the creation and expansion of passive management techniques like *wildlife corridors* to potentially facilitate dispersal between protected areas.[147] Intergovernmental planning and coordination have also played a role.[148] Yet even these alternatives, when implemented, have mostly been fairly passive management strategies. In other words, they establish areas that merely allow the opportunity for migrations, alleviating but not eliminating dispersal barriers that fragment landscapes and thus further impair biodiversity.[149]

Other strategies recognize that regulation of future development alone does not slow down biodiversity loss, let alone improve ecological health. As such, the need to offer *incentives* for private and other non-reserve landowners to promote biodiversity has become increasingly clear.[150] Under the ESA, for example, candidate conservation agreements, the No Surprises policy, and the Safe Harbors policy seek to provide incentives for private protection or reserves beyond regulatory prohibitions.[151] These various strategies, including funding

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6 ECOLOGICAL APPLICATIONS 665 (1996) (describing ecosystem-based management); Jeffrey Sayer, Terry Sunderland, Jaboury Ghazoul, Jean-Laurent Pfund, Douglas Sheil, Erik Meijaard, Michelle Venter, Agni Klintuni Boedhihartono, Michael Day, Claude Garcia, Cora van Oosten & Louise E. Buck, *Ten Principles for a Landscape Approach to Reconciling Agriculture, Conservation, and Other Competing Land Uses*, 110 PROC. NAT'L ACAD. SCIS. 8349 (2013) (explaining landscape-level planning).

146. Endangered Species Act Amendments of 1982, Pub. L. No. 97-304, 96 Stat. 1411 (1982).

147. *See* Kostyack et al., *supra* note 144, at 713–14 (discussing corridors as a potential, but ultimately insufficient, strategy to facilitate dispersal); Mark R. Christie & L. Lacey Knowles, *Habitat Corridors Facilitate Genetic Resilience Irrespective of Species Dispersal Abilities or Population Sizes*, 8 EVOLUTIONARY APPLICATIONS 454, 460–61 (2015) (observing that habitat corridors not only increase ecological health but also genetic resilience).

148. *E.g.*, DANIEL POLLAK, CAL. RSCH. BUREAU, THE FUTURE OF HABITAT CONSERVATION? THE NCCP EXPERIENCE IN SOUTHERN CALIFORNIA 7 (2001) (depicting the program as "in many ways a joint state-federal initiative").

149. *See, e.g.*, *Wildlife Corridors*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/refuges/features/wildlife-corridors.html (last updated Oct. 31, 2019) [https://perma.cc/L2P6-TX6D].

150. *See* FRANK CASEY, SARA VICKERMAN, CHERYL HUMMON & BRUCE TAYLOR, DEFS. OF WILDLIFE, INCENTIVES FOR BIODIVERSITY CONSERVATION: AN ECOLOGICAL AND ECONOMIC ASSESSMENT 7–8 (2006) (explaining incentive programs).

151. Candidate conservation agreements are voluntary compacts between the FWS and landowners to conserve species that are candidates for listing but not yet listed under the ESA. *See Candidate Conservation Agreements*, U.S. FISH & WILDLIFE SERV. (Oct. 2017), https://www.fws.gov/endangered/esa-library/pdf/CCAs.pdf [https://perma.cc/D9K8-2NGD]. Safe harbor agreements are voluntary agreements in which a landowner agrees to contribute to a listed

of private conservation, attempt to encourage landowners to employ more active conservation measures, such as restoration, rather than just avoid development.[152] As such, these potential strategies begin to acknowledge the influence of decisions that occur on human-dominated landscapes on biodiversity loss generally, and on reserved lands in particular, and seek to alter such activities.

E. Substantive Limitations of Public Biodiversity Governance

Though these prevailing strategies have always been at best imperfect promoters of biodiversity, they become especially inadequate in the context of global anthropogenic climate change. Each may have advanced a different, limited goal of biodiversity loss prevention: prevent species from going extinct, limit direct human destruction of habitat, restrict the introduction of invasive species, or set aside some areas for their natural resources.

Yet none are surrogates for more comprehensive forms of biodiversity, such as ecological health. Many commenters have recognized that preventing further human development does not reverse and often may not even address biodiversity loss.[153] Focusing on individual species that are most in danger of extinction may be necessary, but hardly sufficient, for stemming broader notions of biodiversity loss.[154] Restricting the movement of invasive species may be useful but also difficult, if not counterproductive, if it retards

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species' recovery and the FWS provides the landowner (1) assurance of no further requirements and (2) the right to return the land to its baseline condition when the agreement ends. *For Landowners: Safe Harbor Agreements*, U.S. FISH & WILDLIFE SERV. (Jan. 30, 2020), https://www.fws.gov/endangered/landowners/safe-harbor-agreements.html [https://perma.cc/6JHA-HVP7]. The "no surprises" policy assures any landowner that, if that landowner agrees to an HCP, no additional obligations will be imposed should unforeseen circumstances arise. *Habitat Conservation Plans: Frequently Asked Questions*, U.S. FISH & WILDLIFE SERV. (July 15, 2013), https://www.fws.gov/endangered/what-we-do/hcp-faq.html [https://perma.cc/L9FZ-LNCN] (clarifying the "no surprises" policy within the HCPs).

152. *See* sources cited *supra* note 151.

153. *See, e.g.*, LAURA C. HOOD, FRAYED SAFETY NETS: CONSERVATION PLANNING UNDER THE ENDANGERED SPECIES ACT 1 (1998); Michael J. Bean & David S. Wilcove, Editorial, *The Private-Land Problem*, 11 CONSERVATION BIOLOGY 1, 1 (1997) (describing absolute prohibition of habitat destruction as unsuccessful in protecting species on private land); Camacho, *supra* note 85, at 301 (arguing that "merely preventing human development did little" to address biodiversity concerns); U.S. AGENCY FOR INT'L DEV., USAID BIODIVERSITY POLICY 7–8 (2014) (detailing the drivers of biodiversity loss not addressed by merely limiting future development).

154. *See* Carol A. Bloomgarden, *Protecting Endangered Species Under Future Climate Change: From Single-Species Preservation to an Anticipatory Policy Approach*, 19 ENV'T MGMT. 641, 645 (1995) (asserting that policymakers should emphasize "proactive, dynamic protection" over individual species preservation).

valuable species movement.[155] And biodiversity values are obviously not housed solely on protected areas. But these simple biodiversity management strategies are likely to be increasingly ineffective at averting more indirect biodiversity loss from large-scale shifts of conditions due to global anthropogenic climate change.

For endangered species preservation, permit-by-permit regulatory hooks are not likely to even achieve the limited goal of preventing extinction of listed species when the core stressor is a change in climatic conditions that make the species less compatible with its existing habitat.[156] Even the best large multispecies plans that rely on more comprehensive multispecies or ecosystem-based management focus on preserving or restoring preexisting assemblages of species.[157] Such plans are not set up to address when one such species is no longer compatible with the conditions wrought by climate change and needs to migrate elsewhere to thrive. Or when other species need to migrate *into* the plan area to survive.

Reserved lands strategies focused on promoting historical preservation, restoration, or natural preservation may actually run counter to long-term ecological health. Myriad studies conclude that the rate and amount of strain on ecological resources from climate change is outside the range of historical variability, leading to fundamental ecological shifts and transformations.[158] Nonintervention under such circumstances would allow change, but would also be at odds with promoting biodiversity in a number of contexts. Valued species will be unable to migrate without human assistance due to topographical and human-created physical and regulatory dispersal barriers,[159] while

155. *See* Camacho, *supra* note 106, at 255 (arguing that movement of non-native species could be valuable).

156. *See* Bloomgarden, *supra* note 154, at 643–45 (1995) (declaring "the Endangered Species Act's single-species, emergency-room approach" as likely a failure).

157. *See, e.g.*, LOWER COLO. RIVER MULTI-SPECIES CONSERVATION PROGRAM, https://www.lcrmscp.gov/ (last visited Sept. 26, 2020) [https://perma.cc/Y6ZS-4SHW].

158. *See, e.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: IMPACTS, ADAPTATION, AND VULNERABILITY 62–70 (Christopher B. Field, Vicente R. Barros, David Jon Dokken, Katharine J. Mach, Michael D. Mastrandrea, T. Eren Bilir, Monalisa Chatterjee, Kristie L. Ebi, Yuka Otsuki Estrada, Robert C. Genova, Betelhem Girma, Eric S. Kissel, Andrew N. Levy, Sandy MacCracken, Patricia R. Mastrandrea & Leslie L. White eds., 2014) (providing technical evidence demonstrating the impacts of climate change); U.S. GLOB. CHANGE RSCH. PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME II: IMPACTS, RISKS, AND ADAPTATION IN THE UNITED STATES 38 (2018) (illustrating various climate change indicators).

159. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 158, at 324 (describing contemporary barriers to migration); *see also* Alejandro E. Camacho, *Transforming the Means and Ends of Natural Resource Management*, 89 N.C. L. REV. 1405, 1441 (2011) (describing topographical, physical, and regulatory barriers that are "likely to lead to increased conflict between inconsistent management objectives").

new harmful species may be able to shift and reduce overall ecological health.

Climate change heightens the potential conflict between noninterventionist and historical preservation objectives. With the large-scale shifts in climatic conditions, public land managers will increasingly be unable to simultaneously maintain or restore historical conditions and refrain from active management.[160]

Climate change also accentuates the tension between the ESA's species-focused conservation and public land management that concentrates on maintaining or restoring place-based historical fidelity. Of course, such tension already exists. For example, invasive species eradication as part of native ecosystem restoration may contravene the ESA if it were to adversely modify an endangered species' critical habitat (e.g., when the invasive species provides food or shelter for an endangered species).[161] But climate change is likely to make such conflicts much more common—for instance, if preserving a species in the face of global changes necessitates movement to new locations that is antithetical to restoration or preservation objectives.

Regrettably, historical preservation and restoration are poorly positioned to counter biodiversity loss in a changing climate.[162] Conventional historical preservation and restoration strategies would seek to resist immigration of new species that need to shift to adapt to climate change, or they may require active promotion of preexisting species that are increasingly incompatible with changing climatic conditions.[163] As I have stated elsewhere, "Climate change ensures that in many cases there will be escalating ecological and other costs, and diminishing gains from engaging in ecosystem preservation and restoration."[164] Similarly, invasive species laws that prevent species movement to maintain native historical conditions may promote

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160. *See* Camacho, *supra* note 159, at 1432–33 (arguing that active management has become virtually necessary to protect ecological systems).

161. *See, e.g.*, Michael L. Casazza, Cory T. Overton, Thuy-Vy D. Bui, Joshua M. Hull, Joy D. Albertson, Valary K. Bloom, Steven Bobzien, Jennifer McBroom, Marilyn Latta, Peggy Olofson, Tobias M. Rohmer, Steven Schwarzbach, Donald R. Strong, Erik Grijalva, Julian K. Wood, Shannon M. Skalos & John Takekawa, *Endangered Species Management and Ecosystem Restoration: Finding the Common Ground*, 21 ECOLOGY & SOC'Y 19 (2016) (showing population increase of bird species due to habitat created by invasive plant species).

162. *See* Camacho, *supra* note 159, at 1432 ("If maintaining the human-nature dichotomy . . . was ever an attainable goal, it certainly is not now.").

163. *Id.* at 1438–39 (arguing that conventional tactics will not withstand climate change).

164. *Id.* at 1435.

biodiversity in some cases but hinder it in others, such as when a non-native key "valuable" species needs to move to adapt.[165]

National Forests and BLM lands, which are more fundamentally premised on maximizing productivity or sustained yield, in theory might actually be the most adaptable to climate change and biodiversity. This is because they allow for the possibility of adaptability to promote long-term ecological function or integrity.[166] Yet the historical emphasis on consumptive uses and significant discretion provided to the BLM and USFS to implement their management mandates has ensured that these lands remain largely focused on maximizing the yield of certain desired species (such as timber or extractive uses) than on reducing biodiversity loss.[167]

Finally, corridors and other strategies for improving connectivity may increase the opportunity for some species to migrate.[168] But, unfortunately, they will not be feasible or helpful in a variety of circumstances, including for species with slow dispersal rates, in isolated areas, or to overcome large-scale dispersal barriers.[169] Moreover, such passive strategies still raise significant, value-laden questions regarding which species to facilitate and which to impede. Thus, many of the fundamental goals of existing natural resource governance, and the range of strategies used for achieving such objectives, are at best weakly tethered to reducing biodiversity loss.

III. THE PROCEDURAL LIMITATIONS OF PUBLIC BIODIVERSITY GOVERNANCE

As compared to substantive and structural governance, a comparatively substantial amount of attention has been paid in the planning, law, and management literatures most relevant to biodiversity loss to assessing public governance procedures and suggesting ways to better manage uncertainty and complexity. As explained earlier, wicked problems scholars have offered various methods for moderating wicked problems.[170] Typically proposed by

165. *See* Camacho, *supra* note 87, at 873–74 (describing the illogical duality between native and non-native preferences).

166. *See Legal Adaptive Capacity*, *supra* note 19, at 745 (arguing that discretion increases legal adaptive capacity, thereby positioning land well to adapt to climate change).

167. *See id.* at 744.

168. *See, e.g.*, Christie & Knowles, *supra* note 147, at 455, 460–61; Lars A. Brudvig, Ellen I. Damschen, Joshua J. Tewksbury, Nick M. Haddad & Douglas J. Levey, *Landscape Connectivity Promotes Plant Biodiversity Spillover into Non-Target Habitats*, 106 PROC. NAT'L ACAD. SCIS. 9328, 9330–31 (2009).

169. Kostyack et al., *supra* note 144, at 713–14, 716.

170. *See supra* notes 58–63 and accompanying text.

planning scholars, these methods predictably focus on a range of planning frameworks, steps, and techniques for incorporating diverse perspectives in order to foster iterative problem-solving.[171]

In the environmental management and law context, which is especially pertinent to biodiversity loss, an established literature on adaptive management has similarly developed on the limitations of governmental processes for coping with uncertainty and change.[172] Unfortunately, public biodiversity governance's procedural legal adaptive capacity remains limited. The standard public processes used for implementing public biodiversity management and for regulating private activity have not been well structured to promote learning and manage the substantial uncertainties and evolving character of ecological resources. More recent attempts to integrate adaptive management—coping with uncertainty through provisional decisionmaking, monitoring, and adjustment—remain limited but hold significant promise for better managing the complexities of biodiversity loss and changing ecological conditions.

A. Inflexible Conventional Public Processes

Conventional administrative law is far from adaptive. As uncertainty is often understood to be a characteristic trait of environmental risk,[173] even more routine natural resources decisions are regularly made in a context of limited information.[174] Conventional administrative procedures regularly used in natural resources law, such as notice-and-comment rulemaking or permitting as codified in the

171. *See, e.g.*, Kunz & Rittel, *supra* note 58, at 2 (discussing how the process of discourse and information exchange supports problem solving); Jeff Conklin, *Dialogue Mapping: Breaking the Chains of Linear Process*, COGNEXUS INST. 3, 11 (2007) http://www.cognexus.org/webinars/Webinar-new.pdf [https://perma.cc/76XJ-K59K] (detailing dialogue mapping as an approach to solving wicked problems); Rosenhead, *supra* note 60, at 119–20 (proposing a participative and interactive method for complex problem solving); Ritchey, *supra* note 61, at 5–6 (discussing General Morphological Analysis); Jesus Navarro, Peter Hayward & Joseph Voros, *How to Solve a Wicked Problem? Furniture Foresight Case Study*, 10 FORESIGHT 11, 11–12 (2008) (suggesting a "morphological foresight" approach to resolving wicked problems); HORN & WEBER, *supra* note 63, at 5 (proposing mess mapping and resolution mapping for resolving wicked problems).

172. *See infra* notes 173–182 and accompanying text. As these critiques are prevalent and well known in the literature, this Part only briefly summarizes them in the context of public biodiversity governance.

173. *See* Jonathan Remy Nash, *Standing and the Precautionary Principle*, 108 COLUM. L. REV. 494, 498–99 (2008); Talbot Page, *A Generic View of Toxic Chemicals and Similar Risks*, 7 ECOLOGY L.Q. 207, 208–09 (1978).

174. Camacho, *supra* note 159, at 1414.

Administrative Procedure Act,[175] are not well designed for managing uncertainty or reducing mistakes.[176] This is primarily because they rely on a static comprehensive rationality or front-end model of government decisionmaking,[177] which assumes agencies can and should focus most of their attention and resources on initial decisions that are at best occasionally revisited to account for new information or changes in circumstances.[178] Permitting also leans heavily on applicants, whose incentives often do not align with biodiversity conservation, for information generation and analysis.[179]

This front-end approach is especially problematic for implementing "ecological resilience strategies when variability is on the rise and prediction is unreliable."[180] In addition, though ambient and post-decision monitoring are often required, they often are poorly resourced or otherwise deficient.[181] Even rarer is the adjustment of initial decisions to account for new information.[182]

B. Limited Attempts to Promote Procedural Adaptive Capacity

As a result of these shortcomings, many scholars have called for the integration of "adaptive management"[183]—systematic monitoring,

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175. *See* 5 U.S.C. §§ 551-559; *id.* §§ 551(5), 551(7) (defining rulemaking and adjudication); *id.* §§ 701-706 (providing for judicial review of agency action).

176. *See, e.g.*, Craig R. Allen, Joseph J. Fontaine, Kevin L. Pope & Ahjond S. Garmestani, *Adaptive Management for a Turbulent Future*, 92 J. ENV'T MGMT. 1339, 1343 (2011).

177. Craig & Ruhl, *supra* note 66, at 4.

178. Camacho, *supra* note 159, at 1414; Craig & Ruhl, *supra* note 66, at 4–5.

179. *See* Camacho, *supra* note 85, at 324–26 ("Because the HCP program relies so heavily on the permittees . . . , monitoring under the HCP program requires a high level of faith that permittees have both the incentive and the ability to assess conformity with public goals.").

180. Ruhl, *supra* note 20, at 1393.

181. *See, e.g.*, Eric Biber, *The Problem of Environmental Monitoring*, 83 U. COLO. L. REV. 1, 34–52 (2011) (highlighting internal and external obstacles and disincentives agencies face in development and implementation of monitoring programs); MGMT. SYS. INT'L, AN INDEPENDENT EVALUATION OF THE EFFECTIVENESS OF THE U.S. FISH AND WILDLIFE SERVICE'S NATIONAL WILDLIFE REFUGE SYSTEM 20 (2008), https://www.fws.gov/refuges/pdfs/NWRS_Evaluation_FullReport.pdf [https://perma.cc/VVV3-LHBW] ("[O]nly 11% of refuge managers surveyed described the current level of inventory and monitoring work as being mostly or fully sufficient."); Jody Freeman, *Collaborative Governance in the Administrative State*, 45 UCLA L. REV. 1, 28–29 (1997) (discussing how flexible government regimes will "produce better rules that are more likely to accomplish legislative goals" and that rules should be "revised in light of experience").

182. *See* Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1, 37–38, 64 (2009) ("Because such experiments fail to provide incentives for regulators and managers to work with and learn from their counterparts, existing collaborative efforts have added yet another layer of fragmentation to the already disjointed regulatory landscape."); Freeman, *supra* note 181, at 16–17.

183. *E.g.*, INT'L INST. FOR APPLIED SYS. ANALYSIS, ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT 1 (C.S. Holling ed., 1978); C.S. Holling, Lance H. Gunderson & Donald Ludwig,

assessment, and adjustment of resource management decisions—and similar strategies that promote provisionalism and experimentalism[184] to manage uncertainty in natural resources decisionmaking. A growing number of government authorities claim to adopt and rely on adaptive management strategies in managing or regulating the use of natural resources.[185] Some have suggested it is vital in the context of addressing biodiversity loss, particularly for adapting to the effects of global climate change on ecological resources.[186] Though formal adaptive management may not be appropriate in all contexts,[187] broad-scale integration of even less rigorously adaptive strategies, such as contingency[188] or scenario planning,[189] would nonetheless still promote legal adaptive capacity.[190]

Systematic employment of any of these more adaptive processes, however, remains atypical. In the context of biodiversity conservation, there have been numerous useful attempts to engage in more adaptive, coordinated processes. The most thorough effort to do so under the ESA

In Quest of a Theory of Adaptive Change, *in* PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS 3, 21–22 (Lance H. Gunderson & C.S. Holling eds., 2002); GEORGE H. STANKEY, ROGER N. CLARK & BERNARD T. BORMANN, U.S. DEP'T OF AGRIC., ADAPTIVE MANAGEMENT OF NATURAL RESOURCES: THEORY, CONCEPTS, AND MANAGEMENT INSTITUTIONS 31–33 (2005), www.fs.fed.us/pnw/pubs/pnw_gtr654.pdf [https://perma.cc/PH4N-M9RM].

184. Freeman, *supra* note 181, at 28–29; Michael C. Dorf & Charles E. Sabel, *A Constitution of Democratic Experimentalism*, 98 COLUM. L. REV. 267, 328–89 (1998).

185. Camacho, *supra* note 159, at 1415.

186. *See, e.g.*, Hillary M. Hoffmann, *Climate Change and the Decline of the Federal Range: Is Adaptive Management the Solution?*, 15 VT. J. ENV'T L. 262, 263 (2014); Joseph Arvai, Gavin Bridge, Nives Dolsak, Robert Franzese, Tomas Koontz, April Luginbuhl, Paul Robbins, Kenneth Richards, Katrina Smith Korfmacher, Brent Sohngen, James Tansey & Alexander Thompson, *Adaptive Management of the Global Climate Problem: Bridging the Gap Between Climate Research and Climate Policy*, 78 CLIMATIC CHANGE 217, 219 (2006); U.S. FISH & WILDLIFE SERV., RISING TO THE URGENT CHALLENGE: STRATEGIC PLAN FOR RESPONDING TO ACCELERATING CLIMATE CHANGE 15–17 (2010), http://www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf [https://perma.cc/D48B-GSDW].

187. *See, e.g.*, HOLLY DOREMUS, WILLIAM L. ANDREEN, ALEJANDRO CAMACHO, DANIEL A. FARBER, ROBERT L. GLICKSMAN, DALE GOBLE, BRADLEY C. KARKKAINEN, DANIEL ROHLF, A. DAN TARLOCK, SANDRA B. ZELLMER, SHANA JONES & YEE HUANG, CTR. FOR PROGRESSIVE REFORM, MAKING GOOD USE OF ADAPTIVE MANAGEMENT 5–9 (2011), https://cpr-assets.s3.amazonaws.com/documents/Adaptive_Management_1104.pdf [https://perma.cc/PYJ5-5E9H] (noting that while "adaptive management is an important tool" in addressing environmental issues, when not used properly, "it can provide an excuse to delay politically uncomfortable decisions and to inhibit effective public oversight"); Craig & Ruhl, *supra* note 66, at 18–27.

188. Gregg P. Macey, *The Architecture of Ignorance*, 2013 UTAH L. REV. 1627, 1667 (2013) (discussing use of contingency planning to accommodate data gaps in environmental law).

189. *See* 2 MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: SCENARIOS (Steve R. Carpenter, Prabhu L. Pingali, Elena M. Bennett & Monika B. Zurek eds., 2005) (providing an analytical framework that offers tools for addressing ecosystem change through a series of "scenarios").

190. *See Legal Adaptive Capacity*, *supra* note 19, at 733.

was as part of the emphasis on developing more comprehensive, multispecies, multiagency habitat conservation planning.[191] FWS regulations require contingency planning in HCPs for foreseeable changed circumstances,[192] and the agency has long emphasized the value of adaptive implementation.[193] In particular, they promote but rarely require use of adaptive management procedures.[194] Moreover, the federal land agencies have adopted, to varying extents, the use of some form of adaptive management for at least some land management planning.[195] But its use still remains limited in natural resources conservation,[196] with the core procedural infrastructure of natural resources governance (including judicial review) suspicious of and even resistant to effective adaptive management.[197]

It is perhaps unsurprising then that numerous scholars have documented the limitations of the attempted use of adaptive management in integrating provisionalism into natural resources governance. Some have pointed to how adaptive procedures are often elective[198] and that public and private actors typically lack the resources or other incentives to engage in adaptive decisionmaking.[199] Others criticized agency invocation of adaptive management as little

191. *See* Camacho, *supra* note 85, at 334; Cameron W. Barrows, Monica B. Swartz, Wendy L. Hodges, Michael F. Allen, John T. Rotenberry, Bai-Lian Li, Thomas A. Scott & Xiongwen Chen, *A Framework for Monitoring Multiple-Species Conservation Plans*, 69 J. WILDLIFE MGMT. 1333, 1334 (2005); Marj Nelson, *The Changing Face of HCPs*, 18 ENDANGERED SPECIES UPDATE 4, 4–6 (2001) (describing HCPs that successfully integrated adaptive management).

192. 50 C.F.R. §§ 17.22(b)(5), 17.32(b)(5) (2019).

193. *See* Camacho, *supra* note 85, at 329 (discussing the agency's long-claimed "commitment to HCP adaptation during implementation").

194. *See* U.S. FISH & WILDLIFE SERV. & NAT'L MARINE FISHERIES SERV., HABITAT CONSERVATION PLANNING AND INCIDENTAL TAKE PERMIT PROCESSING HANDBOOK 10-27 to 10-33 (2016) (explaining adaptive management and the benefits of incorporating it into an HCP).

195. *See Legal Adaptive Capacity*, *supra* note 19, at 757–58, 767, 781, 792–93, 803 (detailing adoption by various federal land agencies of adaptive management protocols for certain federal lands).

196. *See, e.g.*, Barrows et al., *supra* note 191, at 1335 (describing the limited use of adaptive management procedures in HCPs); Camacho, *supra* note 85, at 335.

197. Craig & Ruhl, *supra* note 66, at 9–10.

198. *See* Camacho, *supra* note 85, at 331.

199. *See* R. Gregory, D. Ohlson & J. Arvai, *Deconstructing Adaptive Management: Criteria for Applications to Environmental Management*, 16 ECOLOGICAL APPLICATIONS 2411, 2413 (2006) (noting that a lack of institutional support can make applying adaptive management very difficult); J. Michael Scott, Brad Griffith, Robert S. Adamcik, Daniel M. Ashe, Brian Czech, Robert L. Fischman, Patrick Gonzalez, Joshua J. Lawler, A. David McGuire & Anna Pidgorna, *National Wildlife Refuges*, *in* PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS AND RESOURCES 5-1, 5-35 (Susan Herrod Julius & Jordan M. West eds., 2008) (discussing the legal, monetary, and administrative barriers that make it difficult to implement adaptive management strategies); Craig & Ruhl, *supra* note 66, at 12–13.

more than a catchphrase[200] or, worse, as a method for enabling action while obscuring or deferring consideration of significant environmental risks.[201] Though monitoring is usually required, it nonetheless remains inadequate even in adaptive management regimes.[202] And although regular adjustment of provisional strategies is supposed to be a core trait of adaptive management, even well-regarded adaptive management experiments have not systematically integrated accumulated information to adjust management actions.[203]

Yet the problem extends beyond the limitations of on-the-ground uses of adaptive management and other flexible decisionmaking protocols. As detailed in the next Part, public biodiversity governance is largely not well designed to manage procedural uncertainties at a large scale. This is because it suffers from the absence of an infrastructure for systematically monitoring, assessing, and adjusting public processes to promote learning and thus more adaptive governance.[204]

IV. THE STRUCTURAL LIMITATIONS OF PUBLIC BIODIVERSITY GOVERNANCE

Beyond the goals, tools, and processes of public biodiversity governance, the structure of governmental authority—to whom authority is allocated, and the relationship between such institutions—considerably influences how well concerns about biodiversity are managed. Few wicked problems scholars, however, have focused on structural considerations, and those who have explored it have largely combined exploration of structural with procedural design.[205] In the

200. Craig & Ruhl, *supra* note 66, at 16.

201. *Legal Adaptive Capacity*, *supra* note 19, at 737; *see* Craig & Ruhl, *supra* note 66, at 11.

202. *See* Camacho, *supra* note 159, at 1416. Moreover, monitoring does not always include the collection of data about ambient conditions, provisional assumptions, and the effectiveness of adopted strategies. *Id.* at 1413–14.

203. *See, e.g.*, DOREMUS ET AL., *supra* note 187, at 11 (noting that "[o]ne of the most significant weaknesses" of adaptive management has been a failure of agencies to deliver on their promises of adaptation); J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L. REV. 424, 427, 461 (2010) (noting that courts "frequently are underwhelmed by how agencies implement adaptive management" in litigation over its use in resource management); Lawrence Susskind, Alejandro E. Camacho & Todd Schenk, *Collaborative Planning and Adaptive Management in Glen Canyon: A Cautionary Tale*, 35 COLUM. J. ENV'T L. 1, 35–38 (2010) (detailing failures by Congress and agencies to adequately collect and incorporate stakeholder feedback in creating the Glen Canyon Dam Adaptive Management Program).

204. Camacho, *supra* note 159, at 1417; Camacho, *supra* note 182, at 64–76.

205. *See, e.g.*, Nancy Roberts, *Wicked Problems and Network Approaches to Resolution*, 1 INT'L PUB. MGMT. REV. 1, 2, 8 (2000) (highlighting tactics for distributing power among stakeholders); Lynelle Briggs, *Tackling Wicked Problems: A Public Policy Perspective*, AUSTL. PUB. SERV. COMM'N, https://www.apsc.gov.au/tackling-wicked-problems-public-policy-perspective (last updated June

context of biodiversity loss, for instance, one set of wicked problems scholars briefly recommend greater development of institutions in combination with "multidisciplinarity" and "taking personal responsibility."[206] Helpfully, Professors Ruhl and Salzman do explore how procedural strategies like predecision assessment, adaptive management, and cost-benefit analysis can be informed by theories such as dynamic federalism, new governance, and transgovernmental networks to help government institutions whittle away at massive problems.[207] In this sense, they do consider how structural considerations can help manage wicked problems. But even their useful analysis and proposal for " 'weak ties' networks" does not attempt to parse the various features and trade-offs of structural design.[208]

More generally, scholars and policymakers have neglected the possibility of distinguishing between three distinctive dimensions of authority—namely, the extent authority is centralized, overlapped, and coordinated.[209] Additionally, insufficient attention has been afforded to how the configuration of authority along these dimensions can, and often should be, altered for different governmental functions.[210] Parsing the allocation of authority in each of these ways can clarify the trade-offs of different allocations, allowing for authority to be tailored in ways that leverage the advantages and address the shortcomings of public biodiversity governance.

As explained in this Part, public biodiversity governance is largely fragmented into many decentralized, at times overlapping, and relatively independent government institutions. There has been a proliferation of various formal and informal structures attempting to manage the relationship of these disparate authorities. Depending on the metric, some have been successful at helping link government management strategies over ecological resources. Others have inadvertently served as yet another layer of concurrent, but

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12, 2018) [https://perma.cc/J2AD-L68Z] (summarizing Roberts, *supra*, and suggesting sharing of problem-solving responsibility and information across government agencies and with nongovernmental entities); Michèle Morner & Manuel Misgeld, *Governing Wicked Problems: The Role of Self-organizing Governance in Fostering the Problem-Solving Capabilities of Public Sector Organizations*, ECPR 3–4 (2014), https://ecpr.eu/Filestore/PaperProposal/f64cbbb5-3fed-4c50-9b9b-da8fc498303b.pdf [https://perma.cc/3UND-KWHS] (noting the need for collaboration between public officials and citizens in resolving wicked problems).

206. Sharman & Mlambo, *supra* note 8, at 276–77 ("The recent foundation of the *Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES)* brings hope, because solutions to wicked problems are not technical or scientific but require institutional, political and philosophical engagements.").

207. Ruhl & Salzman, *supra* note 4, at 95–108.

208. *See id.* at 108, 116–19.

209. REORGANIZING GOVERNMENT, *supra* note 19, at 38–39.

210. *Id.* at 21–30.

uncoordinated, authority. More fundamentally, much of public biodiversity governance still remains fragmented and ill-designed to manage large-scale shifts in conditions that are increasingly problematic for biodiversity conservation.

A. A Baseline of Decentralized, Distinct Authority

As alluded to earlier, there are many public institutions involved in managing or regulating actions affecting biodiversity conservation. Ecological resources are divided largely based on the type of land on which they are located, with the bulk of natural resource management in the United States on federal, state, and local public lands. Even just a focus on federal land management shows decentralized authority over different lands by the USFS, BLM, NPS, and FWS, among others.[211] In addition, each state has at least one land agency that manages actions on its respective state-owned land.[212] These lands are typically organized by type of land being managed or protected, and administering authorities have authority over the range of government functions over that particular land.[213] Baseline management authority of ecological resources in this largely place-based patchwork is fairly decentralized, distinct, and independent, with each state or federal agency charged with relatively exclusive management of its jurisdictional lands.[214]

B. Some Overlap and Limited Coordination

There are a few important regulatory frameworks, however, that create overlap and some formal coordination of authority. The most notable are laws protecting or regulating a particular category of species, including endangered, wildlife, invasive, and agricultural species. As noted earlier, under the ESA, the FWS and NMFS[215] regulate private and public activity that might harm or jeopardize listed wildlife species.[216] Their similarly decentralized authority overlaps with

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211. *Id.* at 33 n.6.

212. *See id.* at 33.

213. *See, e.g.*, *About the California State Lands Commission*, CAL. ST. LANDS COMM'N, https://www.slc.ca.gov/ (last visited Sept. 27, 2020) [https://perma.cc/5LYY-33MC]; *Our Agency's History*, CAL. NAT. RES. AGENCY, https://resources.ca.gov/About-Us/Our-Agencys-History (last visited Sept. 27, 2020) [https://perma.cc/9V8P-A828].

214. *See, e.g.*, sources cited *supra* note 213.

215. *See supra* note 81 and accompanying text (explaining the administration of the ESA through the FWS and NMFS).

216. 16 U.S.C. §§ 1538(a)(1), 1538(a)(2)(C).

those of the federal land agencies, as well as each other.[217] Many states also have promulgated endangered species statutes that follow the general template of the federal ESA, though there are differences in the activities prohibited and allowed without a permit.[218] This authority, administered by state wildlife agencies, overlaps with federal wildlife regulatory authority, as well as state and federal lands management.[219]

These laws can also result in coordinated authority when an endangered species exists in resource areas under the jurisdiction of other agencies. Most notably, section 7 of the federal ESA expressly requires all federal agencies to coordinate with the NMFS (for marine species) or the FWS (for freshwater and wildlife species) when considering actions that might "jeopardize the continued existence" of listed endangered or threatened species or "result in the destruction or adverse modification of" their critical habitats.[220] This coordination, which extends to agency planning, information generation, implementation, and postapproval monitoring,[221] is quite in-depth and hierarchical.[222] Action agencies are largely required to adopt Service recommendations and even abandon the action if the Service determines it is necessary to avoid jeopardy.[223] The ESA also includes a number of less rigorous coordination mechanisms. For example, it requires the FWS to communicate with state authorities for determinations of the critical habitat for listed species.[224]

A second avenue of interjurisdictional coordination is the assortment of federal and state laws that regulate invasive species, which create significant overlap and some interagency coordination. Various federal statutes regulate interstate invasive species movement.[225] Executive Order 13,751, which restricts federal agency

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217. REORGANIZING GOVERNMENT, *supra* note 19, at 38–39; GEORGE CAMERON COGGINS & ROBERT L. GLICKSMAN, PUBLIC NATURAL RESOURCES LAW §§ 17, 29, 32 (2d ed. 2007).

218. *See* Camacho, *supra* note 106, at 200 (giving specific examples of differences in state laws).

219. *See, e.g.*, Camacho et al., *supra* note 93, at 10838, 10841 (explaining that all states but one have endangered species laws and nearly one-third have private land use regulation).

220. 16 U.S.C. § 1536(a)(2).

221. *See* REORGANIZING GOVERNMENT, *supra* note 19, at 113–14 (describing federal interagency coordination under the ESA).

222. Jody Freeman & Jim Rossi, *Agency Coordination in Shared Regulatory Space*, 125 HARV. L. REV. 1131, 1146 (2012).

223. 16 U.S.C. § 1536(b); 50 C.F.R. § 402.14(i) (2019); Bennett v. Spear, 520 U.S. 154, 169–70 (1997).

224. 16 U.S.C. § 1536(a)(2).

225. *See, e.g.*, Lacey Act, 18 U.S.C. § 42 (banning shipment of injurious species); Plant Protection Act, 7 U.S.C. §§ 7701-7786 (targeting the shipment of plant pests); Animal Health Protection Act, 7 U.S.C. §§ 8301-8322 (authorizing the secretary of the treasury to ban any import containing any pest or disease of livestock).

introductions of invasive species,[226] establishes a National Invasive Species Council composed of thirteen federal agencies to help coordinate federal invasive species management.[227] Some state invasive species laws require private and public parties to get permits for the importation and perhaps even in-state release[228] of categories of flora and/or fauna,[229] though some states provide exceptions for certain activities by state agencies.[230] These invasive species laws thus create a patchwork of overlapping governance for the management of invasive species, at least on public lands. They also establish limited coordination through hierarchical permitting processes and venues for communication.

Third, the National Environmental Policy Act ("NEPA") and state analogues establish ad hoc overlapping and coordinated authority over information generation and planning.[231] NEPA requires federal agencies to prepare environmental impact statements disclosing the effects of and alternatives to any proposed "major Federal actions significantly affecting the quality of the human environment."[232] It also requires lead agencies to "consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved."[233] Approximately half of the states have adopted analogous statutes applicable to state and local regulators.[234]

Fourth, the federal government coordinates with state agencies through its funding authority. States receive funds through programs like the federal State Wildlife Grants Program and the Wildlife

226. *See* Exec. Order No. 13,751, 81 Fed. Reg. 88,609, 88,611 (Dec. 8, 2016) (prohibiting federal agencies from introducing any invasive species unless it determines "the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken").

227. *Id.* at 88,610–11, 88,613 (requiring federal agencies to coordinate "to the extent practicable" with other agencies in performing their duties, and requiring the council to create a management plan for promoting "effective interagency coordination").

228. *See, e.g.*, CAL. FISH & GAME CODE § 3515 (West 2020); N.C. GEN. STAT. § 113-292 (2020); ARIZ. REV. STAT. ANN. § 17-306 (2020).

229. *See, e.g.*, ALASKA STAT. § 16.05.921 (2020); ARIZ. REV. STAT. ANN. § 17-306 (2020); IOWA CODE § 481A.47 (2020).

230. For example, a few states grant agencies authority to propagate species necessary for stocking programs. *See, e.g.*, CAL. FISH & GAME CODE § 1007 (West 2020); IDAHO ADMIN. CODE r. 13.01.03.100(01)(j) (2010).

231. National Environmental Policy Act, 42 U.S.C. §§ 4321-4375.

232. *See id.* § 4332(2)(C).

233. *See id.*

234. *See* Bradley C. Karkkainen, *Toward a Smarter NEPA: Monitoring and Managing Government's Environmental Performance*, 102 COLUM. L. REV. 903, 905 n.7 (2002) (stating that over twenty-five states have emulated NEPA).

Conservation and Restoration Program if they adopt a wildlife action plan assessing the condition of a state's wildlife and outlining necessary conservation actions.[235] Consequently, the federal government does influence state wildlife and ecosystem planning through funding and coordination with states.

In addition to these more formal forms of coordination, a wide assortment of ad hoc, voluntary, and/or less rigorous coordination arrangements have proliferated. Under the ESA, for instance, a number of local, state, and federal agencies have elected to contribute to multiagency HCP arrangements.[236] These plans provide sustained opportunities for place-based, interjurisdictional coordination and collaboration throughout planning, permitting, implementation, and enforcement.[237] But whether alternatively called councils, committees, task forces, commissions, or working groups, most coordination arrangements have taken the form of interjurisdictional networks for coordinating information gathering and planning between disparate authorities.[238] Much coordination is extemporaneous, informal, and voluntary; it simply provides opportunities for increased communication between authorities rather than more rigorous coordination between public institutions.[239] Moreover, coordination mechanisms are often focused on only a particular space or resource.[240] As a result, robust interjurisdictional coordination remains the exception and not the rule in biodiversity conservation, with most authority over natural resources still exercised fairly independently.[241]

235. *See* 16 U.S.C. § 669c(e)(1).

236. *See* Camacho, *supra* note 85, at 302–06 (noting that "the HCP program's agreement-based approach to regulation" has been "instituted as a method for reinventing regulation to address widespread concerns regarding the ineffectiveness and adversarialism of existing decisionmaking processes" by encouraging meaningful participation by various stakeholders).

237. *Id.*

238. Camacho, *supra* note 182, at 29–30; Ruhl & Salzman, *supra* note 4, at 41–45 (discussing fora using "weak ties" to alleviate the effects of fragmentation).

239. *See* Freeman & Rossi, *supra* note 222, at 1156 (describing considerable informal coordination between agencies); Camacho, *supra* note 182, at 30–36 (detailing the limited efficacy of place-based intergovernmental coordination mechanisms).

240. *See, e.g.*, Christensen et al., *supra* note 145, at 682 (arguing for coordination efforts to match the scale of a larger ecosystem); R. Edward Grumbine, *What Is Ecosystem Management?*, 8 CONSERVATION BIOLOGY 27 (1994) (advocating for a more holistic process because large-scale ecosystem management has not been "consistently applied by federal or state management agencies").

241. Camacho, *supra* note 182, at 26–28.

C. Trade-offs of Predominant Structure for Biodiversity Protection

Though there are undoubted advantages to this cascading network of largely decentralized, somewhat distinct, and relatively independent authority, it is also not particularly well tethered for addressing many of the more conventional indirect stressors on biodiversity. The decentralization of authority allows for the development and application of particularized agency expertise, strategies that are tailored to diverse contexts, and opportunities for experimentation and cross jurisdictional learning by regulators.[242] Such a framework works particularly well for managing fairly discrete, varied, and localized resources, as well as more direct biodiversity stressors such as proposed human encroachments.

Decentralization, however, also has costs. In particular, a largely decentralized framework is not well equipped to address transboundary and cumulative harms.[243] Of course, many of the stressors that lead to biodiversity loss, such as habitat fragmentation and invasive species, are paradigmatic examples of such harms. Decentralized authority can also lead to lack of uniformity,[244] such as disparate treatment of species movement, which can either impede valuable migrations or fail to stem harmful ones.[245] And decentralization might forfeit administrative efficiencies from economies of scale available through a more centralized configuration.[246]

Similarly, keeping authority distinct over different resources (such as public lands) raises trade-offs. On the one hand, it can minimize administrative or compliance costs.[247] It can also help limit the risk of conflicting regulation.[248] On the other hand, vesting authority exclusively means there is no regulatory safety net, increasing the risks of regulatory capture and under-regulation—

242. REORGANIZING GOVERNMENT, *supra* note 19, at 34.

243. *Id.* at 36.

244. *Id.* at 36–37.

245. Camacho, *supra* note 159, at 1438–39.

246. *See, e.g.*, Daniel C. Esty, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570, 613–14 (1996) (stating that centralized efficiencies are more apparent in areas that are not "local-information intensive"); Daniel C. Esty, *Toward Optimal Environmental Governance*, 74 N.Y.U. L. REV. 1495, 1562–63 (1999) (explaining the information-sharing benefits of this approach); Jonathan H. Adler, *Jurisdictional Mismatch in Environmental Federalism*, 14 N.Y.U. ENV'T L.J. 130, 148–49 (2005) (observing this phenomenon in a product-standards context).

247. Freeman & Rossi, *supra* note 222, at 1150; Jacob E. Gersen, *Overlapping and Underlapping Jurisdiction in Administrative Law*, 2006 SUP. CT. REV. 201, 214.

248. *See* Freeman & Rossi, *supra* note 222, at 1150; Jason Marisam, *Interagency Administration*, 45 ARIZ. ST. L.J. 183, 223 (2013) (noting how the Environmental Protection Agency's ("EPA") centralization helped unify Obama-era policy).

particularly concerning for biodiversity loss, with the potential for irreversible harm.[249] A key advantage of ESA section 7—one of the few relatively hierarchical coordination mechanisms in public biodiversity governance—is precisely that it injects a safety net and anticapture safeguards into federal agency decisionmaking.[250]

Likewise, there are advantages and disadvantages to relying on largely independent authority in public biodiversity governance. It can avoid administrative costs from coordination, reduce risks of government inaction, and promote arguably beneficial competition between government institutions.[251] Yet lack of coordination is also more likely to lead to regulatory inconsistencies over resource management; inefficiencies due to the failure to pool expertise; risks of regulatory failure from agency shirking, mission drift, and free riding; and even a race to the bottom from intergovernmental competition,[252] such as between states over resource use and exploitation.[253]

Indeed, much of the proliferation of place-based, ad hoc coordination in public biodiversity governance is likely induced by a desire to foster consistency and share resources and knowledge on specific environmental problems.[254] But because they are often organized around particular issues or places, some of these coordination arrangements actually run the risk of merely adding another layer of governance, increasing regulatory costs without meaningfully addressing the disadvantages of decentralized and somewhat overlapping governance.[255] As such, the baseline public biodiversity governance framework is not especially well designed to address conventional indirect stressors to biodiversity, such as invasive species and habitat fragmentation.

D. Increased Overlap Through Climate Change

Unfortunately, the existing regulatory structure is even less equipped for managing the alarming effects of climate change on

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249. *See* REORGANIZING GOVERNMENT, *supra* note 19, at 41–43.

250. *See* 16 U.S.C. § 1536 (providing rules for "interagency cooperation" in implementing the ESA); Jon Hasselman, *Holes in the Endangered Species Act Safety Net: The Role of Agency "Discretion" in Section 7 Consultation*, 25 STAN. ENV'T L.J. 125, 128–38 (2006) (providing an overview of the ESA's history and arguing that "even agency actions that can be viewed as 'nondiscretionary' are prohibited by § 7 if they will cause jeopardy").

251. REORGANIZING GOVERNMENT, *supra* note 19, at 46–48.

252. *Id.* at 47–49.

253. *See, e.g.*, Noah D. Hall, *Toward a New Horizontal Federalism: Interstate Water Management in the Great Lakes Region*, 77 U. COLO. L. REV. 405, 453 (2006).

254. *E.g.*, POLLAK, *supra* note 148, at 6–7.

255. Camacho, *supra* note 182, at 36, 48.

biodiversity. As stated earlier, climate change is compounding already significant pressures on biodiversity that are increasing risks of extinction.[256] Rising temperatures will also cause changes in reproductive timing and behavior, timing of migration patterns, and shifts in habitat ranges northward and toward higher elevations that will "fundamentally rearrange U.S. ecosystems" and "alter ecosystem structure, function, and services, leading to predominantly negative consequences for biodiversity and the provision of ecosystem goods and services."[257]

Yet climate change is testing the resilience of the structure of public biodiversity governance in ways that are at least as troubling as these physical effects. The pressures of widespread changes in climatic conditions that are accelerating species movement also substantially increase jurisdictional overlap between the many decentralized government institutions charged with regulating and managing biodiversity loss. As wildlife and vegetation respond to altered climatic conditions over the next century, landscapes may no longer be suitable for preexisting flora and fauna long considered "native."[258] These species will have to emigrate elsewhere to survive, with many species facing extinction unless they can move considerable distances to adapt or their movement is actively facilitated.[259] Relatedly, other—more compatible and very possibly non-native—immigrants will be needed to fill the niches vacated by those that emigrated.[260]

Yet the largely segmented and uncoordinated authority that predominates public biodiversity governance was not designed to manage these widespread range shifts, contractions, and expansions of ecological resources that will blur the distinctions between legally

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256. The EPA determined years ago that "clear evidence" demonstrates "climate change is exerting major influences on natural environments and biodiversity, and these influences are generally expected to grow with increased warming." Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496, 66,534 (Dec. 15, 2009).

257. *Id.* at 66,498.

258. *See* Camacho, *supra* note 106, at 181–83 (describing the specific drivers and problems associated with newly uninhabitable conditions).

259. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 158, at 14–15; Thompson Webb III, *Past Changes in Vegetation and Climate: Lessons for the Future*, *in* GLOBAL WARMING AND BIOLOGICAL DIVERSITY 59, 60 (Robert L. Peters & Thomas E. Lovejoy ed., 1994) (discussing the loss of plant ranges due to climate change); O. Hoegh-Guldberg, L. Hughes, S. McLntyre, D. B. Lindenmayer, C. Parmesan, H. P. Possingham & C. D. Thomas, *Assisted Colonization and Rapid Climate Change*, 321 SCIENCE 345, 345 (2008). A leading but often-contested article in *Nature* concluded that by 2050, up to two-thirds of species will need to migrate or be moved to new habitats to survive. Thomas et al., *supra* note 53, at 145.

260. *See* Malcolm L. Hunter, *Climate Change and Moving Species: Furthering the Debate on Assisted Colonization*, 21 CONSERVATION BIOLOGY 1356, 1357 (2007).

discrete lands. Beyond the limitations of the existing substantive goals and strategies for biodiversity management identified in Part II, keeping authority predominantly decentralized, poorly coordinated, and increasingly overlapping will create substantial barriers to needed migrations.

Climate change will make the difficulties in addressing transboundary concerns for decentralized authority increasingly prominent. And the additional overlap in authority due to the increased pressure for species migrations will substantially increase the potential for regulatory conflict. Species movement will be constrained not only by physical obstructions to dispersal, but also by management differences between jurisdictions. Vulnerable flora and fauna will need to move from one designated land category to another, but the management objectives of those new jurisdictions may hinder or bar such migration.[261] Regulatory conflict is also likely to increase between these place-based laws of public lands and species-focused conservation laws, like those governing endangered and invasive species.[262] The ESA, for example, might demand protections for migrating listed species that other public lands might categorize as invasive.[263] Left unaddressed, the increased overlap paired with little or weak coordination is likely to exacerbate some of the preexisting limitations of public biodiversity governance.

E. Limited Interjurisdictional Learning

Unfortunately, public biodiversity governance is also weakened by the general absence of any infrastructure for promoting interjurisdictional learning and thus more adaptive governance.[264] This structural concern builds on the procedural one identified in Part III regarding limited integration of adaptive decisionmaking. The focus here, however, is on the lack of a centralized or coordinated framework for generating, disseminating, or analyzing information about adopted management strategies. Natural resource laws typically do not require or otherwise promote the systematic generation of information about

261. *See* Camacho, *supra* note 106, at 188 (describing the factors that determine the legality of assisted migration).

262. For example, if a member of a listed endangered species attempts to migrate through designated wilderness outside its historical range, such movement arguably would be barred by the Wilderness Act. *See id.* at 198–99. It also might be considered invasive under federal or state invasive species laws. *See id.* at 199–201.

263. For possible conflicting laws, see, for example, the Plant Protection Act, 7 U.S.C. §§ 7701-7786, the Lacey Act, 18 U.S.C. § 42, and the Alien Species Prevention and Enforcement Act, 39 U.S.C. § 3015.

264. Camacho, *supra* note 159, at 1417; Camacho, *supra* note 182, at 50.

the efficacy of programs and government institutions.[265] While assessments by nongovernmental organizations may occasionally provide some relevant information, such analyses are not part of a legitimating public process of systematic monitoring, assessment, and adjustment.[266] Nor is there any infrastructure for the broad dissemination of assessment data, even among partner institutions governing similar natural resources.[267]

As a result, the capacity of public biodiversity governance to reduce uncertainty by learning about the effectiveness of past management actions is largely untapped. Existing decentralized and even distinct authority can be useful for providing avenues for experimentation, tailored strategies, and learning. But these opportunities for learning are wasted if there is no centralized or coordinated infrastructure for gathering and sharing such information more broadly.

This deficiency is of particular concern in light of the various ways that climate change magnifies uncertainties for the management of ecological resources.[268] In part, this is because climate change is bringing a wide range of changes, and often there is no readily available past analog on which resource managers can draw for making management decisions.[269] There is significant uncertainty regarding the exact local effects and efficacy of possible management strategies in preventing or reducing the harmful effects of climate change. Climate change involves more complex and potentially confounding variables than most environmental issues, and localized modeling needed to aid adaptation decisions is improving but remains difficult.[270] But this uncertainty is compounded because: (1) information about the performance of adopted strategies is rarely ever systematically

265. *See, e.g.*, Alejandro E. Camacho, *Beyond Conjecture: Learning About Ecosystem Management from the Glen Canyon Dam Experiment*, 8 NEV. L.J. 942, 955–56 (2008) (explaining the failure to implement a program to "monitor, evaluate, and adjust" the titular program over the last ten years).

266. *Cf.* Camacho, *supra* note 85, at 343–44 (discussing how requiring governmental actors to systematically monitor and adapt programs not only provides vital information but also promotes accountability and legitimacy).

267. *See* Bradley C. Karkkainen, *"New Governance" in Legal Thought and in the World: Some Splitting as Antidote to Overzealous Lumping*, 89 MINN. L. REV. 471, 495 (2004) (describing the lack of "information-pooling" in HCPs); Karkkainen, *supra* note 234, at 946–48 (making reporting and transparency suggestions).

268. Camacho, *supra* note 182, at 10–15.

269. *Id.* at 13.

270. *See* Camacho, *supra* note 159, at 1409–13.

generated, and (2) there are insufficient avenues for sharing information between existing regulatory authorities.[271]

V. PROMOTING ADAPTIVE PUBLIC BIODIVERSITY GOVERNANCE

Too often, even governance scholars who recognize the challenges raised by complex problems like biodiversity conflate the three key components of governance or only emphasize certain aspects to the detriment of others. Yet the strategies, processes, and structures of governance can and should be reshaped to better resist and manage biodiversity loss.

A. Goals and Strategies to Advance Biodiversity

1. Prioritizing Ecological Health

Substantive conservation management can be reshaped to better promote biodiversity in a changing world. Rather than tethering biodiversity law to the preservation, restoration, wildness, or consumptive goals that predominate natural resources law, climate change necessitates managing ecological resources to more directly promote biodiversity.[272] This certainly does not mean that cultural conservation goals such as historical and wildness preservation, or more consumptive goals such as sustained yield, must be categorically discarded. But their emphasis will be increasingly costly to biodiversity should they remain a greater priority. For biodiversity loss to decelerate, if not be reversed, the substantial portfolio in the United States of reserved public lands and regulated ecological resources needs to be reinvested more substantially in promoting ecological health. A number of scholars have in fact sought to reframe restoration and preservation to be less tethered to historical fidelity and more focused on restoring ecological health or function.[273]

Of course, a shift toward prioritizing biodiversity and away from conventional restoration, historical preservation, wildness

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271. *See id.* at 1415–20.

272. *See* Bruce A. Stein, Amanda Staudt, Molly S. Cross, Natalie S. Dubois, Carolyn Enquist, Roger Griffis, Lara J. Hansen, Jessica J. Hellmann, Joshua J. Lawler, Erik J. Nelson & Amber Pairis, *Preparing for and Managing Change: Climate Adaptation for Biodiversity and Ecosystems*, 11 FRONTIERS ECOLOGY & ENV'T 502, 505 (2013) (arguing for a more proactive and forward-looking approach to ecological support).

273. *Cf.* Stephen T. Jackson & Richard J. Hobbs, *Ecological Restoration in Light of Ecological History*, 325 SCIENCE 567, 567–68 (2009) (emphasizing the value of "predisturbance restoration targets," but nonetheless asserting that "[e]cological restoration finds new moorings in emphasizing restoration of ecosystem function, goods, and services"); Alyson C. Flournoy,

preservation, or sustained yield is no more than the initial judgment. As I have suggested before, ecological conservation might be framed broadly to promote some notion of future ecosystem function, health, or "quality."[274] This might include biodiversity conservation, but also could be understood as promoting the productivity of a particular favored resource or set of resources.[275] It might be realized as maximizing aggregate biomass, though even so there might be various different metrics for measuring such an objective.[276]

Defining, measuring, and advancing biodiversity alone as a goal is also fraught.[277] Measures of biodiversity commonly refer to richness (number of unique life forms), evenness (equitability among life forms), and heterogeneity (dissimilarity among life forms),[278] but these are overlapping concepts.[279] If and how they should be aggregated remains unsettled,[280] with scholars offering numerous metrics for biodiversity[281] and its conservation.[282] Management strategies also might focus on genetic, population, species, assemblage, or ecosystem diversity, or

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Restoration Rx: An Evaluation and Prescription, 42 ARIZ. L. REV. 187, 195–96 (2000) ("[S]uccessful restoration must focus on the functioning of the system as a whole . . . . This dictates a focus on processes, not endpoints, and on systems, not individual organisms or species."). *See generally* Dan Tarlock, *Slouching Toward Eden: The Eco-Pragmatic Challenges of Eco-Revival*, 87 MINN. L. REV. 1173 (2003) (pointing out flaws in an ecological approach that is backwards-looking and concerned with preserving a status quo).

274. *See, e.g.*, Camacho, *supra* note 25, at 555–56.

275. *See, e.g.*, Casey P. TerHorst & Pablo Munguia, *Measuring Ecosystem Function: Consequences Arising from Variation in Biomass-Productivity Relationships*, 9 CMTY. ECOLOGY 39, 39 (2008) (explaining that productivity is one important measure of ecosystem function and that the current operational definition of net productivity is biomass produced per unit of time).

276. *Id.* (describing a variety of measures to estimate productivity, including annual rainfall, oxygen measurements, standing biomass, and changes in biomass).

277. *See supra* note 33 and accompanying text.

278. Cardinale et al., *supra* note 7, at 60.

279. Andy Purvis & Andy Hector, *Getting the Measure of Biodiversity*, 405 NATURE 212, 213 (2000).

280. *Id.* at 218 ("[B]iodiversity cannot be reduced to a single number . . . . We must of course recognize — and explain to policy-makers — that combining these dimensions into a single number would be arbitrary.").

281. *See, e.g.*, Matt Davis, Søren Faurby & Jens-Christian Svenning, *Mammal Diversity Will Take Millions of Years to Recover from the Current Biodiversity Crisis*, 115 PNAS 11262, 11262 (2016) (asserting that phylogenetic diversity is a better metric of biodiversity than species richness or functional diversity); Tom Leinster & Mark W. Meckes, *Maximizing Diversity in Biology and Beyond*, 18 ENTROPY 88 (2016) (advocating for an entropy-based approach); Charles W. Fowler, *Maximizing Biodiversity, Information, and Sustainability*, 17 BIODIVERSITY & CONSERVATION 841 (2008) (using the Shannon-Weiner information index to calculate the anthropogenic effects on biodiversity).

282. *See, e.g.*, Faith, *supra* note 33 (describing "safe minimum standard" for biodiversity as an alternative to triage).

some segment or combination thereof.[283] And of course different strategies might be directed at different concerns. Accordingly, which particular manifestation of biodiversity conservation is adopted, and how such a goal is measured and operationalized, will play an incredibly significant role in the management strategies adopted—and, in the context of global climate change, which species movements are allowed, or even assisted.[284]

As I have also argued elsewhere, a focus on promoting or prioritizing particular ecological processes in an ecosystem may provide more concrete components to center on once the tether to promoting native and restricting non-native is no longer available.[285] A fertile and growing ecosystem services literature emphasizes identifying and measuring the beneficial services of ecosystems.[286] These include provisioning services (such as production of food and water), regulating services that help control climate and disease, supporting services that cycle nutrients and produce, and cultural services like recreational or spiritual benefits.[287]

But even so, the measurement and prioritization of these various different services for any particular landscape or ecosystem is value-laden and contestable.[288] Public biodiversity governance and associated academic disciplines (such as environmental ethics, economics, ecology, and conservation biology) must accelerate and deepen the investigation and discussion of how to measure and reconcile these many values and trade-offs. A shift to a greater emphasis on promoting biodiversity and ecological health is a necessary first step that would greatly facilitate such examinations and debates.

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283. *See* Michael E. Soulé, *Conservation: Tactics for a Constant Crisis*, 253 SCIENCE 744, 744 (1991).

284. *See* Faith, *supra* note 33 ("[T]he choice among these different biodiversity 'models' will depend on what values are important to the decision-maker.").

285. Camacho, *supra* note 25, at 564; *cf.* Faith, *supra* note 33 (describing how a focus on valuing ecosystem processes arguably promotes maintenance and evolution of ecosystems and biodiversity).

286. *See, e.g.*, Christian Layke, Measuring Nature's Benefits: A Preliminary Roadmap for Improving Ecosystem Service Indicators 3 (Sept. 2009) (unpublished manuscript), https://files.wri.org/s3fs-public/pdf/measuring_natures_benefits.pdf [https://perma.cc/2F4W-BP9Y]; CLAIRE BROWN, ABISHA MAPENDEMBE, LISA INGWALL KING & JEANNE L. NEL, U.N. ENV'T PROGRAMME WORLD CONSERVATION MONITORING CTR., MEASURING ECOSYSTEM SERVICES: GUIDANCE ON DEVELOPING ECOSYSTEM SERVICE INDICATORS (2014).

287. *See, e.g.*, MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: SYNTHESIS, at vi (2005), https://www.millenniumassessment.org/documents/document.356.aspx.pdf [https://perma.cc/VD5X-48BX].

288. *See* Faith, *supra* note 33 (contrasting those arguing for valuation metrics with those claiming it is "doomed to failure" (quoting BRYAN G. NORTON, THE PRESERVATION OF SPECIES 202 (1986)).

2. A Rigorous and Active Toolkit

Whichever manifestations of ecological health are adopted, a reorientation toward more directly promoting biodiversity in natural resources management would likely require a pervasive transition away from primarily reactive and retrospective strategies toward incorporation of more diverse and active interventions tethered to some form of ecological health in light of future climatic conditions. Promoting future ecological health in public lands planning and management likely would include, depending on the land management regime, a de-emphasis on maximizing consumptive use, preserving or restoring preexisting assemblages of species, and minimizing human intervention.[289] Invasive species laws might curtail categorical resistance to human introductions and non-native movement (while allowing any native movement) and make the central inquiry whether a particular movement is expected to aid or detract from ecological health.[290]

The ESA and other species management laws should continue but go further than the recent shift from permit-by-permit regulatory hooks to more purposefully manage cumulative and indirect stressors, such as invasive species or habitat fragmentation. Multispecies, ecosystem-based, and landscape-level planning[291] might provide increased opportunities for addressing biodiversity loss beyond species extinction, such as ecological vulnerabilities to non-endangered species or habitat. Moreover, ESA recovery plans could be adequately funded and enforceable,[292] as well as address broader ecological health concerns (such as biodiversity loss to non-listed species or ecological functions not linked to listed species). But wildlife management could go beyond trying to preserve preexisting biotic assemblages to manage ecological change and transition areas to protect if not enhance ecological health.[293] This likely would need to include a much broader portfolio of passive strategies than reserved lands or even wildlife corridors.

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289. *See Legal Adaptive Capacity*, *supra* note 19, at 717–20.

290. *See* Camacho, *supra* note 87, at 900.

291. *See supra* notes 144–146 and accompanying text.

292. *See, e.g.*, Justin Berchiolli, *Stewarding Species: How the Endangered Species Act Must Improve*, 10 U.C. IRVINE L. REV. 1079, 1081–83, 1085 (2020) ("Even if policymakers were to adopt regulations promoting and overseeing species recovery, increasing the regulatory burden . . . without equally increasing [the] funding may not translate to . . . progress.").

293. *See* Camacho, *supra* note 106, at 228, 234, 244 (advocating for wildlife management strategies that seek to not only protect and restore pre-existing biota but also to facilitate new biotic development).

Providing private incentives to promote biodiversity beyond financial subsidies may also be critical. Some scholars have called for substantially more attention to the management of private property and landscapes and waterways between protected areas—the "matrix lands"—to increase their permeability.[294] For example, forests might be managed in ways that leave higher densities of trees standing.[295] Agricultural lands might be required or incentivized to maintain soft borders (such as windbreaks, shelter belts, and filter strips) or otherwise provide avenues for species movement or transition to agroecological uses.[296] Freshwater and coastal land management might remove subsidies that spur connectivity-reducing development, restore natural floodplains, or remove impassable culverts to allow for easier movement of fish.[297] And land development might be regulated or incentivized to reduce wildlife impacts, such as through the use of preferred plants, fencing, or wildlife over- and underpasses.[298] The challenge with this suite of strategies will be increasing the permeability of lands in ways that promote valuable species movement but also impede those movements likely to harm biodiversity.

But promoting biodiversity conservation in a world of landscape-scale climatic changes might also require increased reliance on more active, interventionist strategies in some contexts.[299] These might include assisted migration and translocation outside of existing ranges to overcome large-scale dispersal barriers in light of anticipated climatic conditions,[300] and even perhaps build on past strategies, such as captive breeding, to integrate biotechnological approaches.[301] But it is clear that the goals and strategies of conservation law can and should be shaped to better advance biodiversity in a changing world.

B. Adaptive Processes with Presumptions of Nativity

Effective biodiversity governance also requires the integration into regulatory processes of standards that facilitate species movement and even introductions that are favorable to ecological health, while limiting (if not eliminating) those migrations or translocations that are not. In my view, this means typically rejecting essentialist

294. Kostyack et al., *supra* note 144, at 714.

295. *Id.*

296. *Id.* at 715.

297. *Id.*

298. *Id.* at 716.

299. Camacho, *supra* note 106, at 247.

300. *See id.* at 233–34.

301. *See* Camacho, *supra* note 87.

classifications that categorically protect movements if an organism pre-existed, or because it is moving without direct human assistance.[302] Similarly, both active introductions and movement of species outside their historical range should not be entirely barred.[303]

Instead, public biodiversity governance processes should rely on cautious risk assessments of the trade-offs of species movements.[304] These might be in conjunction with rebuttable presumptions, such as that the movement of an ecological unit is appropriate in locations where it already exists or existed.[305] Likewise, there might be a presumption—but not a bar—against immigration or intentional translocations to areas outside a species' historical or current range.[306]

With or without default presumptions, adoption of particularized risk assessments for species movements must be paired with more adaptive decisionmaking. Just as the rigidity of public biodiversity governance is well trodden in the literature on adaptive management and governance, so are the general attributes of essential changes. Many have suggested the need for integrating resilience and adaptability in decisionmaking to manage the variability and uncertainty of biodiversity loss through greater reliance on techniques like adaptive management. These allow not only provisional decisions based on existing information, but also incremental policy and decision adjustments at the back end if conditions warrant.[307] As adaptive management may not be appropriate or feasible in all circumstances, less rigorous alternatives such as contingency planning can incentivize iterative planning and periodic adjustments and thus increase procedural adaptive capacity.[308]

Instigating adaptive processes not only at the project level but more programmatically is crucial, however.[309] In my view, effective adaptive procedural governance requires not only empiricism and experimentalism in implementing on-the-ground conservation strategies. It also necessitates more systematic monitoring,

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302. *Id.*

303. *See* Camacho, *supra* note 106, at 200 (giving state law examples for potential non-native introduction rules).

304. Camacho, *supra* note 87, at 897–902.

305. *Id.* at 902–05.

306. *Id.* at 903.

307. *See, e.g.*, Ruhl & Fischman, *supra* note 203, at 429 (stating that the adaptive management framework relies on "iterative cycles of goal determination, model building, performance standard setting, outcome monitoring, and standard recalibration . . . .").

308. *See, e.g.*, Macey, *supra* note 188, at 1667 (discussing use of contingency planning to accommodate data gaps in environmental law).

309. *See, e.g.*, Camacho, *supra* note 85, at 342.

assessment, and adjustment of agency policies, programs, and even processes.[310]

C. Coordinated Learning by Distinguishing Functional Authority

Both the wicked problems and adaptive management literatures, however, have overlooked that the allocation of authority in public biodiversity governance also can and should be transformed, oriented more toward managing both conventional and emerging indirect cumulative stressors on biodiversity. Many have pointed out that the fragmentation of authority in biodiversity management impedes its success.[311] Those who consider it, however, too often conflate different components of structural authority.

1. Disaggregating Public Governance

The allocation of authority among institutions can and should be disaggregated. As Professor Robert Glicksman and I have argued in a range of contexts, policymakers need to distinguish between three different dimensions of authority: the extent authority is centralized or decentralized, the extent to which authority overlaps between different institutions or is distinct, and the extent to which authority is coordinated or independent.[312] As illustrated in Part IV, each of these dimensions raises a range of trade-offs.[313]

Moreover, in both allocating authority and assessing the trade-offs of doing so, policymakers should differentiate between the range of implicated government functions—funding, data generation, information compilation and distribution, information analysis, planning, standard setting, implementation and permitting, inspection and compliance monitoring, and enforcement.[314] For example, the trade-offs of centralizing information dissemination are different than

310. Camacho, *supra* note 182, at 76.

311. *See, e.g.*, Gregory N. Mandel, *Gaps, Inexperience, Inconsistencies, and Overlaps: Crisis in the Regulation of Genetically Modified Plants and Animals*, 45 WM. & MARY L. REV. 2167, 2231–42 (2004) (discussing the coordinated framework's regulatory gaps, inconsistencies, inexperience, and duplication); PEW INITIATIVE ON FOOD & BIOTECHNOLOGY, ISSUES IN THE REGULATION OF GENETICALLY ENGINEERED PLANTS & ANIMALS 10–13, 18 (2004), http://www.pewtrusts.org/~/media/legacy/uploadedfiles/phg/content_level_pages/reports/foodbiotechregulation0404pdf.pdf [https://perma.cc/ZF9P-TYDQ] (discussing the coordinated framework's issues of legal uncertainty, regulatory gaps, inconsistency, and lack of coordination).

312. REORGANIZING GOVERNMENT, *supra* note 19, at 35–49.

313. *See supra* Section IV.C.

314. *See* REORGANIZING GOVERNMENT, *supra* note 19, at 56–57 (discussing which functions are better fits for certain organizational structures and how that can change over time).

those for permitting.[315] Similarly, overlapping authority in enforcement can be paired with more distinct or even exclusive authority for standard setting.[316] And different forms or degrees of interagency coordination may be employed for planning and permitting.[317] As illustrated below, attending to these distinctions can help policymakers adjust public biodiversity governance to better accomplish regulatory goals, including allocating authority to institutions in ways that manage and reduce uncertainty and promote learning.

2. Reorienting Public Biodiversity Institutions

Any coherent effort to manage wildlife movement to limit extinction and maintain ecosystem productivity and biodiversity is likely to require tailored but vital alterations to public biodiversity governance's baseline of decentralized, increasingly overlapping, but, at best, weakly coordinated authority. Introducing different forms of coordination for certain functions can help promote intergovernmental learning and address other structural limitations of public biodiversity governance. Moreover, judicious increases in centralization for funding and even standard setting on migration and introduction strategies help tackle concerns about transboundary harms, promote harmonization, and leverage economies of scale. Yet it also maintains the expertise, diversity, and experimentation advantages of still primarily decentralized authority.

a. Tailored Coordination and Centralization

Instituting forms of coordination over information dissemination and generation, planning, and implementation—paired with more centralized financing and standard setting over wildlife movement—could help address concerns regarding lack of harmonization and transboundary harms exacerbated by climate change. First, to deal with the considerable uncertainty about the effects of climate change and effectiveness of potential management strategies, there is a credible argument that the federal government should develop a framework of hierarchically *coordinated information dissemination* on ecological resources. To truly promote interjurisdictional learning on resource management, such a clearinghouse would have to include not only scientific information about ecological effects, but also systematic

315. *Id.* at 66.

316. *Id.* at 98–100.

317. *See id.* at 120–23 ("Varying the extent of coordination among functions should heighten the advantages of coordination while minimizing its disadvantages.").

reports on the past performance of management strategies.[318] As *information generation* would be undertaken by those entities adopting and implementing management strategies, policymakers would need to oblige resource agencies to regularly monitor, assess, and adjust adopted management strategies based on their performance in light of regulatory goals and targets.

In addition, *coordination of biodiversity planning* and *implementation* would help reconcile the increased conflict among ecological resource management authorities from the migration effects of climate change. Increased reliance on mechanisms akin to some already used in natural resources law might help manage the increased intersection of authority due to species movement. NEPA and its state analogs will continue to provide opportunities for horizontal coordination of information generation and planning on the effects and alternatives to proposed federal management of ecosystems. Policymakers might even borrow from the ESA's allocation of authority and adjust such laws to require more hierarchical coordination of implementation as well.[319] NEPA and its progeny, however, only contemplate coordination in the context of declared governmental actions.[320] In contrast, the fundamental question in managing the effects of climate change on biodiversity is not how a proposed human action may affect the environment, but rather how to manage the indirect effects of climate change on species movement and biodiversity.

As such, proactive biodiversity conservation may necessitate governmental planning in contexts in which direct human action has *not* been proposed.[321] A weaker, more horizontally coordinated approach might be a collaborative infrastructure that brings resource management authorities together to engage in broader biodiversity planning.[322] But interjurisdictional planning could be adapted to require more rigorous coordination, such as required harmonization of

318. *See* Camacho, *supra* note 182, at 66.

319. *See* REORGANIZING GOVERNMENT, *supra* note 19, at 100–23.

320. Kleppe v. Sierra Club, 427 U.S. 390, 399 (1976). *See also* Daniel A. Farber, *Adaptation Planning and Climate Impact Assessments: Learning from NEPA's Flaws*, 39 ENV'T L. REP. NEWS & ANALYSIS 10605, 10608 (2009) (detailing the process by which the acting agency must consult environmental agencies with specific expertise).

321. *See* Farber, *supra* note 320, at 10607 (explaining how climate change flips the reorientation of planning away from the conventional focus on how proposed human actions affect the environment and toward how the environment may affect humans).

322. For example, the now-defunct Federal Interagency Adaptation Task Force was a modest step toward interagency climate adaptation coordination. Exec. Order No. 13,653, 78 Fed. Reg. 66,819 (Nov. 1, 2013) (revoked by Exec. Order No. 13,783, 82 Fed. Reg. 16,093 (Mar. 28, 2017)). However, it was almost entirely federal and not designed to prioritize goals or manage interagency conflict, but largely for communication only. *See id.* at 66,819–23.

strategies or charging a single institution with final approval. For implementation, a more hierarchical coordination model might be ESA section 7's interagency consultation requirement,[323] modified to require consultation with federal wildlife agencies not only on endangered species but also other categories of migrating ecological resources such as invasive and other major migrating species.

A more *centralized* approach, with potential transboundary cost internalization advantages, might involve the establishment and prioritization of federal ecological management *standards* and priorities related to migrating ecological resources. Similarly, centralizing at the federal level the bulk of *financing* for migration or translocation efforts might make sense. This might both take advantage of the federal government's superior capacity to pool funding and provide a conduit for coordinating planning requirements and standards with state resource managers.

Combining centralized standard setting and financing with differentially coordinated systems of information generation, dissemination, and planning could serve to proliferate opportunities for information sharing and cultivate learning. This, in turn, should help reduce the barriers to regulation exacerbated by uncertainty. Furthermore, providing a transparent means for assessing agency progress toward regulatory goals would help promote more effective agency decisionmaking and regulator accountability.[324] It should also promote benefits in increased connectivity between lands through more coordinated planning and standard setting.

b. Continued Decentralized Baseline

There are strong arguments for retaining *decentralized* control of some functions as well, such as *implementation* of specific conservation strategies with state and federal resource agencies. Decentralized authority would allow for a range of management strategies in implementation, which would facilitate the development of specialized approaches tailored to local variations and resource-specific circumstances. Furthermore, maintaining decentralized implementation would continue to provide opportunities for regulatory experimentation. To promote such management customization and experimentation, the choice of concrete management strategies related

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323. 16 U.S.C. § 1536(a)(2).

324. *See* Camacho, *supra* note 182, at 65–70 (discussing how a publicly accessible clearinghouse would increase intergovernmental information sharing).

to wildlife movement should likely remain with each agency delegated authority over a particular land or resource.

Such decentralized implementation would serve to reduce uncertainty when accompanied with the broader coordinated system of information sharing. Requiring horizontal coordination of information generation and dissemination, and hierarchically coordinated (or even centralized) standard setting, accommodates the core experimentation benefits of decentralized governance by allowing jurisdictions to learn from the experiences of other regulatory authorities. The existence of many different regulatory authorities provides considerable opportunities for experimentation and interjurisdictional learning.[325] In conjunction with pressuring regulators to learn through mandated planning, providing resource managers access to such information and communication will help promote the potential customization and experimentation benefits of decentralized authority. Because such an approach neither requires agency consolidation nor agreement on a particular management strategy, making such information broadly available is valuable whether agencies engage in collaborative efforts or act independently in exercising their implementation and enforcement functions.[326]

c. Judicious Overlap with Division of Primacy

Finally, though there are likely to be considerable benefits from maintaining overlapping authority over transboundary ecological movement for some governmental functions, there will also be opportunities to minimize inefficiencies for duplication over other functions. In light of the increase in interaction among jurisdictions and the substantial uncertainty that accompanies climate change, identifying a single regulatory scale for managing ecological resources will remain difficult. A model of overlapping authority, with its greater safety net advantages (albeit with likely greater inefficiencies), would be particularly valuable for minimizing risks of irreversible harm to

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325. Adler, *supra* note 246, at 137.

326. *See* William W. Buzbee, *The Regulatory Fragmentation Continuum, Westway and the Challenges of Regional Growth*, 21 J.L. & POL. 323, 353 (2005) ("Even if inter-jurisdictional competition is viewed as a good, one can embrace allocation of such information-gathering functions to federal actors.").

biodiversity.[327] This might especially be the case for functions such as planning and enforcement.[328]

Integrating hierarchical coordination mechanisms between authorities, however, can help manage some of the potential risks of inaction from overlap. For example, empowering an agency (such as the FWS) with the authority to assess and authorize strategies proposed by others—both measures for promoting beneficial species, such as introductions, as well as restrictive management measures proposed to manage detrimental species—can help ensure overlap does not overly restrict ecologically valuable movements.

Moreover, though some overlap of authority may have benefits, this does not mean that authority cannot be lodged primarily or even exclusively to one institution for certain actions or functions. For example, though it might make sense to allow the FWS, state wildlife agency, and state land manager to be involved in endangered species migration on state land, many of the safety net benefits of overlapping authority might be reaped by overlap of only a few functions. All three might participate in the information generation and planning process; the FWS might be charged primarily with information dissemination, financing, and standard setting; and information analysis and implementation could be lodged in the state land management agency. In short, though overlapping regulatory authority coalesced around particular substantive areas may make sense for ecological resources, such jurisdictional redundancy may be better focused on certain governmental functions rather than perfunctory and full duplication for every function.

CONCLUSION

For decades, scholars and policymakers have dedicated considerable time to understanding and attempting to manage incredibly complex problems. This literature has spawned a variety of labels for these great challenges, with some outlining detailed approaches for characterizing them. And though some seem to accept inevitable defeat in addressing these issues, others have offered frameworks for tackling them. Virtually all, however, have focused primarily on the possible development of *procedural* mechanisms, with

327. *See* Camacho, *supra* note 182, at 66–68 (discussing the benefits of intergovernmental information gathering on climate change); Ruhl, *supra* note 20, at 1400–02 (touting the benefits of overlapping redundancy of "dynamic federalism" with regards to climate change).

328. *See* REORGANIZING GOVERNMENT, *supra* note 19, at 99–100.

few actually distinguishing process from the substantive and structural aspects of governmental authority.

Yet, at least in the context of addressing biodiversity loss, attending to substantive and structural legal adaptive capacity, in addition to procedural adaptive capacity, is critical. In particular, public biodiversity governance processes must evolve to be more adaptive; it is at least as important that policymakers integrate more *substantive* legal adaptive capacity into public institutions. Express integration of ecological health as a core objective of public lands, endangered species, and invasive species laws is a start, but it also necessitates the proliferation of more flexible and interventionist strategies such as translocations and cultivating land permeability that seek to more actively manage ecological change.

Similarly, policymakers also must consider the role of *structural* legal adaptive capacity. Varying the extent of centralization, overlap, and coordination by the government function at issue can better leverage the advantages of different dimensions of authority while minimizing weaknesses. In the context of public biodiversity governance, adjustments to predominantly decentralized, overlapping, and weakly coordinated authority are necessary to manage growing transboundary risks, reduce harmful anticipated regulatory conflict, and promote intergovernmental learning. Tailored increases in coordination for information generation, dissemination, planning, and implementation—combined with centralization of standard setting and financing—might effectively address these concerns while retaining the expertise, diversity, and experimentation advantages of still primarily decentralized authority of implementation. Similarly, allocating overlapping authority for planning and enforcement, but more distinct authority to centralized and decentralized authorities (such as standard setting and implementation, respectively), can provide a valuable safety net for biodiversity while minimizing wasteful duplication.

Of course, these suggested reallocations are merely preliminary possibilities. As there is at best limited information gathered about the efficacy of different substantive strategies, procedures, and allocations of authority, perhaps as important as the adjustment of substantive, procedural, and structural authority is the institution of an adaptive governance infrastructure that builds such assessments into public biodiversity governance.[329] More procedural *and* structural adaptive governance, which integrates such analyses systematically into the regulatory process itself, is essential. While calls for adaptive governance have primarily sought to build systematic empirical

329. *Id.* at 235.

evaluation of substantive and procedural strategies into regulatory decisionmaking, more adaptive structural governance would embed the analysis of the best ways to structure government—a learning infrastructure—into the administrative state as well.[330] To more effectively tackle biodiversity loss and other complex problems—indeed, to whittle away at the wicked problem of good public governance—scholars and policymakers must try to reconstruct governance to build capacities to learn from successful and unsuccessful ventures, using the resulting insights to engender further reforms.

330. *Id.* at 236.