

12-2020

## Designing Law to Enable Adaptive Governance of Modern Wicked Problems

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### Recommended Citation

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Available at: <https://scholarship.law.vanderbilt.edu/vlr/vol73/iss6/4>

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# Designing Law to Enable Adaptive Governance of Modern Wicked Problems

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*In the twenty-first century, our planet is facing a period of rapid and fundamental change resulting from human domination so extensive it is expected to be visible in the geologic record. The accelerating rate of change compounds the global social-ecological challenges already deemed “wicked” due to conflicting goals and scientific uncertainty. Understanding how connected natural and human systems respond to change is essential to understanding the governance required to navigate these modern wicked problems. This Article views change through the lens of complexity and resilience theories to inform the challenges of governance in a world dominated by such massive and relentless disruption.*

*The new theories of governance discussed in this Article have been developed through empirical observation of emerging governance innovation to fill governance gaps that have opened with the increasing complexity of society. Among them, adaptive governance has been described as emerging in environmental governance and described in the resilience literature as a promising means to manage modern wicked problems. Adaptive governance is observed to emerge, and does so, in situations of conflict with high uncertainty in environmental management outcomes.*

*This Article contributes to the development of adaptive governance theory by articulating and situating the role of formal law and government as*

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*the facilitator, but not central controller, of adaptive governance. To advance the understanding of adaptive governance, we argue that it can be understood in the broader context of scholarship covering the observed emergence of new governance, the efforts to develop theoretical understandings through decentered theory, and the refinement of constitutional understanding through democratic experimentalism. Synthesis of these three themes in turn informs the role of law and government in working with emergent governance responses to complexity to manage change and wicked problems. This inter- and transdisciplinary exercise reveals that the role of law and government in adaptive governance is to leave space for local innovation and private governance. Law and government must provide the catalyzation, facilitation, steering, and oversight essential for public and private institutions to respond at the rate and complexity of change in large-scale social-ecological systems, and they must do so while advancing good governance.<sup>†</sup>*

|   |      |
|---|------|
| INTRODUCTION.....   | 1689 |
| I. ACCELERATING CHANGE.....   | 1692 |
| A. <i>The Twentieth-Century Scientific Revolution in the Study of Complex Systems</i> ..... | 1694 |
| B. <i>Complexity as Context for Governance</i> .....  | 1698 |
| II. GOVERNANCE TRENDS WITH INCREASING COMPLEXITY.....                                       | 1705 |
| A. <i>Coevolving Society and Governance</i> .....   | 1706 |
| B. <i>New Governance</i> .....  | 1710 |
| C. <i>Emerging Trends in Environmental Governance: Towards Adaptive Governance</i> .....    | 1713 |
| III. ADAPTIVE LAW: ENABLING GOVERNANCE FOR COMPLEX SOCIAL-ECOLOGICAL SYSTEMS .....          | 1721 |
| A. <i>Situating Law Within the Adaptive Governance Literature</i> .....                     | 1722 |
| B. <i>Unpacking the Role of Formal Law and Government in Adaptive Governance</i> .....      | 1727 |
| CONCLUSION.....   | 1731 |

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<sup>†</sup> The concepts discussed in this paper were inspired by the work of the Adaptive Water Governance (AWG) Project (co-led by B. Cosens and L. Gunderson) supported by funding from the U.S. National Socio-Environmental Synthesis Center (SESYNC) under funding from the U.S. National Science Foundation, NSF DBI-1052875; by the research project “Adaptive Capacity for Sustainable Blue Growth” (BlueAdapt) funded by the Strategic Research Council of Finland; and by a collaboration between AWG and the Finnish BlueAdapt project, known as the Adaptive Water Governance Project 2.0, funded through SESYNC. The authors would like to dedicate this article to the memory of C. S. (Buzz) Holling, whose groundbreaking work on resilience theory and adaptive management, intellectual curiosity, quest for big ideas, and openness to diverse disciplines and experiences in pursuit of that quest has greatly influenced the work of each of us. The authors are thankful to Margaret Palmer and Jonathan Kramer of SESYNC for their continued support of this work.

## INTRODUCTION

In 1973, Rittel and Webber<sup>1</sup> used the term “wicked” to describe value-laden problems in which goal formation, problem definition, and equitable solution options are contested. Objective application of expertise alone cannot solve a wicked problem.<sup>2</sup> In working with the list of attributes of wicked problems Rittel and Webber identified,<sup>3</sup> which has become “rooted in many research fields,”<sup>4</sup> it is important to understand that their conceptualization arose in the planning context (e.g., how to design the transit system for a major city) during the social upheaval of the 1960s and 1970s.<sup>5</sup> At the time, general systems theory, which emphasizes explaining complex patterns or behaviors that arise from interactions of key system components,<sup>6</sup> was coming of age to address environmental problems, but it either received little application or was rejected by the social and political sciences.<sup>7</sup> Modern complex environmental problems, such as climate change, share the core attributes Rittel and Webber described but also include elements of rapid social change and increasing complexity as societies enter the age of globalization, the digital revolution, and human domination of

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1. Horst W.J. Rittel & Melvin M. Webber, *Dilemmas in a General Theory of Planning*, 4 POL’Y SCIS. 155, 160 (1973).

2. *Id.* at 156.

3. *Id.* at 161–66:

1. There is no definitive formulation of a wicked problem . . . 2. Wicked problems have no stopping rule . . . 3. Solutions to wicked problems are not true-or-false, but good-or-bad . . . 4. There is no immediate and no ultimate test of a solution to a wicked problem . . . 5. Every solution to a wicked problem is a “one-shot operation”; because there is no opportunity to learn by trial-and-error, every attempt counts significantly . . . 6. Wicked problems do not have an enumerable (or exhaustively desirable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan . . . 7. Every wicked problem is essentially unique . . . 8. Every wicked problem can be considered to be a symptom of another problem . . . 9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem’s resolution . . . 10. The planner has no right to be wrong.

4. 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, 168 (2019).

5. Kate Crowley & Brian W. Head, *The Enduring Challenge of ‘Wicked Problems’: Revisiting Rittel and Webber*, 50 POL’Y SCIS. 539, 541 (2017).

6. LUDWIG VON BERTALANFFY, GENERAL SYSTEM THEORY: FOUNDATIONS, DEVELOPMENT, APPLICATIONS 3–5 (1968); *see also* Ralph H. Abraham, *The Genesis of Complexity*, 67 WORLD FUTURES 380, 380–84 (2011) (detailing the roots of complexity theory).

7. *See* B. Guy Peters, *What Is So Wicked About Wicked Problems? A Conceptual Analysis and a Research Program*, 36 POL’Y & SOC’Y 385, 385 (2017) (noting that the Rittel and Webber article served as a precursor for the development of complexity theories in the social sciences). Note that systems-related theories of complexity, adaptation, and resilience will be discussed in greater detail in Part I.

the planet.<sup>8</sup> In taking the efforts to address wicked problems from a planning perspective to much broader governance realms, it is clear that the core attributes Rittel and Webber outlined, combined with an accelerated rate of change, high uncertainty, and a timeframe that implicates intergenerational equity, compound the lack of fit between traditional governance and the challenges it is intended to manage. The development of systems approaches, such as complexity and resilience theory from biophysical sciences, has challenged the social sciences to update their models, leading to reconceptualization of these “modern” wicked problems.

In a growing body of interdisciplinary scholarship that bridges biophysical and social sciences in addressing environmental issues, the evidence of emergence of *adaptive governance* has been described and offered as a promising means to manage modern wicked problems. Here we use *governance* as a broad term that includes, but goes beyond, *government*. As political scientist Mark Bevir defines these terms, “Whereas government refers to political institutions, governance refers to processes of rule wherever they occur.”<sup>9</sup> Thus, governance includes private as well as public action, with formal law and government being only a subset of governance. What separates adaptive governance from other strands of governance theory is the realization that wicked problems are changing in their dynamics at accelerating rates and with increasingly uncertain futures. Consequently, governance must not only rely on institutions beyond government, it must do so *adaptively*.

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8. See Will Steffen, Paul J. Crutzen & John R. McNeill, *The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?*, 36 *AMBIO* 614 (2007) (discussing human domination of Earth’s systems in the context of the geologic record).

9. MARK BEVIR, *GOVERNANCE: A VERY SHORT INTRODUCTION* 3 (2012) [hereinafter BEVIR, *GOV. INTRO*]; see also MARK BEVIR, *A THEORY OF GOVERNANCE* 17 (2013) [hereinafter BEVIR, *THEORY GOV.*] (the author is the leading expert on the increasing emergence of non-government centered governance in Western democracies); MARK BEVIR, *KEY CONCEPTS IN GOVERNANCE* 3 (2009) [hereinafter BEVIR, *KEY CONCEPTS*] (describing the key aspects of governance). For the definition used in the AWG Project see Barbara Cosens & Lance Gunderson, *An Introduction to Practical Panarchy*, in *PRACTICAL PANARCHY FOR ADAPTIVE WATER GOVERNANCE: LINKING LAW TO SOCIAL-ECOLOGICAL RESILIENCE* 1, 3 (Barbara Cosens & Lance Gunderson eds., 2018) [hereinafter *PRACTICAL PANARCHY*]. See, e.g., PETER ROGERS & ALAN W HALL, *GLOB. WATER P’SHIP TECH. COMM., EFFECTIVE WATER GOVERNANCE* 4 (2003), <http://www.gwp.org/Global/ToolBox/Publications/Background%20papers/07%20Effective%20Water%20Governance%20%282003%29%20English.pdf> [https://perma.cc/2X68-RA6P] (“Governance generally involves mediating behaviour via values, norms, and, where possible, through laws.”). See *GOVERNANCE FOR THE ENVIRONMENT: NEW PERSPECTIVES* (Magali A. Delmas & Oran R. Young eds., 2009) (noting that the demand for governance is increasing at the same time that confidence in governments to provide such is waning); UNITED NATIONS SYS. TASK TEAM, UNITED NATIONS DEPT’ ECON. & SOC. AFFS., UNITED NATIONS DEV. PROGRAMME & UNITED NATIONS EDUC., SCI. & CULTURAL ORG., UN SYSTEM TASK TEAM ON THE POST-2015 UN DEVELOPMENT AGENDA: *GOVERNANCE AND DEVELOPMENT* (2012), [http://www.un.org/millenniumgoals/pdf/Think%20Pieces/7\\_governance.pdf](http://www.un.org/millenniumgoals/pdf/Think%20Pieces/7_governance.pdf) [https://perma.cc/TN5F-WVTB] (describing governance as the means through which collective goals are chosen, decisions are made, and action is taken to achieve the chosen goals).

2020]

*ENABLING ADAPTIVE GOVERNANCE*

1691

Adaptive governance theory developed to make sense of emerging forms of environmental governance responding to complexity and to help conceptualize how society can grow more nimble in the face of the daunting social-ecological changes ahead.

This Article contributes to the development of adaptive governance theory by articulating and situating the role of formal law and government within the broader enterprise of governance and by discussing the key implications of complexity and resilience theories for governance in general and for law in particular. We make three core arguments. First, conceptualizing modern wicked problems requires a firm understanding of theories that arose from the study of complex systems, characterized by high levels of interacting variables, nonlinearity, and deep uncertainty. Second, adaptive governance is an emergent, context-specific response in complex systems that fosters distributed governance, embraces democratic experimentalism to generate an ever-broadening realm of governance processes and actors, and increases the capacity of society to manage change and uncertainty in complex social-ecological systems. Third, to take advantage of this emergent response of society to complexity, the role of formal law and government is not one of central controller, but rather one of facilitator, which requires law and government themselves to be adaptive.

Our discussion proceeds in three parts corresponding to our core arguments. Part I explores why the unique attributes of this time in history call for new approaches to governance of wicked problems, arguing that the science of complexity, as incorporated into resilience theory, informs how best to conceptualize the governance challenge. Part II reviews the history of scholarship on emergence of governance innovation in Western democracies since the 1980s, which has led to increasingly distributed governance with both private and public actors playing significant roles. The discussion focuses on how the progression of governance experiments demonstrates patterns that reflect aspects of complexity and resilience theory. It then turns to the trends in empirical work, scholarship, and practice in environmental governance that led to the initial observation of emergence of a new form of governance, from which the broader concept of adaptive governance was developed. Finally, Part III seeks to inform the development of adaptive governance through a synthetic understanding of complexity and governance and to consider the efficacy of this approach in the face of growing complexity of wicked problems. While emerging approaches to distributed governance are promising for managing resilience, they are not emerging fast enough to address accelerating change, and they are proceeding ahead and outside of governmental checks on good governance, including legitimacy, transparency, accountability, equity,

and justice. To address this gap, Part III concludes by analyzing the governmental role in accelerating emergence of adaptive governance and calling for legal authority and government leadership to act in both a facilitative role and as the arbiter of good governance.

### I. ACCELERATING CHANGE

The forms of governance discussed in this paper are emerging to fill gaps related to the increasing complexity of society. Governance gaps in areas that include climate change, globalized economies, and landscape-scale ecosystem and water basin management exist and are widening as the complexity of interrelated social, ecological, and technological systems accelerates.<sup>10</sup> Understanding how systems respond to change is therefore essential to understanding the governance required to navigate that change.

Throughout geologic time, the planet Earth has experienced punctuated change. While the scale of geologic time may spread change over millennia, rendering it invisible on a human time scale, the geologic record displays change in relatively abrupt cycles visible today in unconformities, record sea level and climate change, and mass extinctions.<sup>11</sup> In the twenty-first century, the planet is in a period of change expected to be visible in the geologic record, occurring on a human time scale, and resulting from human domination of the earth. Both the geologic<sup>12</sup> and the popular or policy literature<sup>13</sup> refer to this

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10. See MICHAEL P. VANDENBERGH & JONATHAN M. GILLIGAN, BEYOND POLITICS: THE PRIVATE GOVERNANCE RESPONSE TO CLIMATE CHANGE 8–16 (2017) (discussing governance gaps in climate change); Barbara A. Cosens, Lance Gunderson & Brian C. Chaffin, *Introduction to the Special Feature Practicing Panarchy: Assessing Legal Flexibility, Ecological Resilience, and Adaptive Governance in Regional Water Systems Experiencing Rapid Environmental Change*, 23 *ECOLOGY & SOC'Y*, no. 1, 2018, at 4–8, <https://doi.org/10.5751/ES-09524-230104> [<https://perma.cc/N2K8-4KJ4>] (PDF download available at URL provided) (discussing governance gaps in landscape scale ecosystems and water basins); Scott Burris, Michael Kempa & Clifford Shearing, *Changes in Governance: A Cross-Disciplinary Review of Current Scholarship*, 41 *AKRON L. REV.* 1, 41 (2008) (discussing governance gaps in globalized economies).

11. Unconformity: a vertical section of rock in which the contact line between rocks below and above reflects a gap in time—these represent significant geologic events in Earth's history. Extinctions: a significant change in biodiversity and species present. EDWARD J. TARBUCK & FREDERICK K. LUTGENS, *EARTH: AN INTRODUCTION TO PHYSICAL GEOLOGY* 251, 598, 619 (9th ed. 2008).

12. Colin N. Waters, Jan Zalasiewicz, Colin Summerhayes, Anthony D. Barnosky, Clément Poirier, Agnieszka Galuszka, Alejandro Cearreta, Matt Edgeworth, Erle C. Ellis, Michael Ellis, Catherine Jeandel, Reinhold Leinfelder, J.R. McNeill, Daniel deB. Richter, Will Steffen, James Syvitski, Davor Vidas, Michael Wagemann, Mark Williams, An Zhisheng, Jacques Grinevald, Eric Odada, Naomi Oreskes & Alexander P. Wolfe, *The Anthropocene Is Functionally and Stratigraphically Distinct from the Holocene*, 351 *SCIENCE* 137, 137 (2016).

13. Steffen et al., *supra* note 8, at 614; Will Steffen, Åsa Persson, Lisa Deutsch, Jan Zalasiewicz, Mark Williams, Katherine Richardson, Carole Crumley, Paul Crutzen, Carl Folke, Line Gordon, Mario Molina, Veerabhadran Ramanathan, Johan Rockström, Marten Scheffer,

epoch as the Anthropocene. Scientists limit their identification of the new epoch to those things known to be present globally over the surface of the earth, including fly ash, plastics, nuclear fallout, habitat loss, invasive species, and climate change as recorded in changing sea levels and biodiversity.<sup>14</sup> The popular literature would add that the planet is currently undergoing loss of biodiversity at a rate that is equal to or exceeds that of the five other mass extinctions in the 3.5 billion year geologic record of life on Earth,<sup>15</sup> and it is approaching other planetary boundaries involving biogeochemical cycling.<sup>16</sup>

What is truly unique about the Anthropocene is that global environmental change coincides with accelerating rates of change in social systems—namely, globalization, the digital revolution, and population growth neatly characterized as the Great Acceleration.<sup>17</sup> Thus, the utility of understanding the complex response of systems to disturbance is to inform how society might navigate accelerating change on a human timescale. This Section explores the science that informs understanding of complex systems and how systems facing change evolve.

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Hans Joachim Schellnhuber & Uno Svedin, *The Anthropocene: From Global Change to Planetary Stewardship*, 40 *AMBIO* 739, 739 (2011); MELINDA HARM BENSON & ROBIN KUNDIS CRAIG, THE END OF SUSTAINABILITY: RESILIENCE AND THE FUTURE OF ENVIRONMENTAL GOVERNANCE IN THE ANTHROPOCENE 1 (2017); THOMAS L. FRIEDMAN, THANK YOU FOR BEING LATE: AN OPTIMIST'S GUIDE TO THRIVING IN THE AGE OF ACCELERATIONS 187–88 (Picador 2017) (2016); ELIZABETH KOLBERT, THE SIXTH EXTINCTION: AN UNNATURAL HISTORY 107 (2014).

14. Waters et al., *supra* note 12, at 137.

15. KOLBERT, *supra* note 13, at 15–16. Note that despite the preference of environmentalists the International Stratigraphy Commission Working Group on the Anthropocene cannot yet determine if this will show in the geologic record; however, to the extent that it is the result of loss of habitat, it is included in their basis for epoch recommendation. Working Grp. on the 'Anthropocene', *Results of Binding Vote by AWG Released 21st May 2019*, SUBCOMM. ON QUATERNARY STRATIGRAPHY, <http://quaternary.stratigraphy.org/working-groups/anthropocene/> (last visited Sept. 26, 2020) [<https://perma.cc/2KN5-PJKX>]; see also Damian Carrington, The Anthropocene Epoch: Scientists Declare Dawn of Human-Influenced Age, *GUARDIAN* (Aug. 29, 2016, 8:00 AM), <https://www.theguardian.com/environment/2016/aug/29/declare-anthropocene-epoch-experts-urge-geological-congress-human-impact-earth> [<https://perma.cc/ZA5N-WJHH>] (discussing the debate surrounding designation of the epoch).

16. Steffen et al., *supra* note 8, at 615; Steffen et al., *supra* note 13, at 753–54; Will Steffen, Katherine Richardson, Johan Rockström, Sarah E. Cornell, Ingo Fetzer, Elena M. Bennett, Reinette Biggs, Stephen R. Carpenter, Wim de Vries, Cynthia A. de Wit, Carl Folke, Dieter Gerten, Jens Heinke, Georgina M. Mace, Linn M. Persson, Veerabhadran Ramanathan, Belinda Reyers & Sverker Sörlin, *Planetary Boundaries: Guiding Human Development on a Changing Planet*, 347 *SCIENCE* 736, 736 (2015).

17. Steffen et al., *supra* note 8, at 617; Steffen et al., *supra* note 13, at 743; FRIEDMAN, *supra* note 13, at 254 (placing the inflection point in accelerating change at 2007).



*A. The Twentieth-Century Scientific Revolution  
in the Study of Complex Systems*

The Anthropocene unfolded in concert with a scientific revolution in which understanding of planetary processes reached a level that allowed scientists not only to identify the global imprint of human activities but to begin to understand consequences of those activities. Various approaches, such as general systems theory,<sup>18</sup> complexity theory,<sup>19</sup> and resilience theory,<sup>20</sup> were developed to help recognize and understand patterns of change across a range of systems. These three theories in particular also helped provide a basis for translating knowledge to action in environmental systems. In cases that link environmental and economic systems (such as fisheries management),<sup>21</sup> understanding system behavior is vital to governing human interventions. We argue that governance and design of governmental structures and processes can be informed by understanding the behavior of systems from these different theoretical perspectives.

Systems can be characterized in a myriad of ways, but a distinction between simple and complicated systems on one hand and complex systems on the other offers a valuable starting point for understanding them.<sup>22</sup> In studying a simple system, such as a mechanical clock, you find a limited number of levers, pulleys, and pins that operate under a specific set of rules (laws of motion) and produce a rather standardized outcome (hands moving clockwise at a regular pace). The system may be *complicated* in the number of components and their interactions, but the operation of the system can be understood and predicted once all the components and their mechanics have been mapped out.<sup>23</sup> *Complex* systems, such as tropical rainforests, oceans, societies, or the global economy are a stark contrast in comparison. In

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18. See FRITJOF CAPRA & PIER LUIGI LUISI, *THE SYSTEMS VIEW OF LIFE: A UNIFYING VISION* (2014) (discussing systems theory).

19. VON BERTALANFFY, *supra* note 6, at 34; see also Abraham, *supra* note 6, at 380–84 (detailing the history and origins of complexity theory).

20. See C.S. Holling, *Resilience and Stability of Ecological Systems*, 4 ANN. REV. ECOLOGY & SYSTEMATICS 1, 1–23 (1973) (using mathematical formulations to describe interaction in ecosystems and developing resilience theory to describe the results of adaptation and regime shift).

21. See Barbara Cosens & Alexander Fremier, *Assessing System Resilience and Ecosystem Services in Large River Basins: A Case Study of the Columbia River Basin*, 51 IDAHO L. REV. 91 (2014) (applying resilience theory to the complex tradeoffs between salmon and hydropower in the Columbia River to understand system adaptive capacity and the potential for tipping points).

22. PAUL CILLIERS, *COMPLEXITY AND POSTMODERNISM: UNDERSTANDING COMPLEX SYSTEMS* 2–3 (1998); JOHN H. HOLLAND, *COMPLEXITY: A VERY SHORT INTRODUCTION* 3–4 (2014).

23. HOLLAND, *supra* note 22, at 4–5.

addition to being complicated, these systems are also complex. The distinction goes to the essence of complexity science theory:

In a complicated world, the various elements that make up the system maintain a degree of independence from one another. Thus, removing one such element (which reduces the level of complication) does not fundamentally alter the system's behavior apart from that which directly resulted from the piece that was removed. Complexity arises when the dependencies among the elements become important. In such a system, removing one such element destroys system behavior to an extent that goes well beyond what is embodied by the particular element that is removed.<sup>24</sup>

*Systems thinking* is based on this understanding of complexity in systems. Systems thinking arose in the first half of the twentieth century out of the study of living systems and the recognition of patterns arising from interactions that are not present in the reductionist study of the components alone.<sup>25</sup> It represented a revolution in Western science, and this approach has been used in the application of scientific understanding to real world management issues.<sup>26</sup>

Systems science began to flourish in the 1950s with the development of general systems theories and methods (such as mathematical modeling, measurements, and experiments) to test those theories. Biologist Ludwig von Bertalanffy developed systems models to reconcile paradoxes between physical system rules (such as the laws of thermodynamics) and living systems.<sup>27</sup> Beginning in the 1960s, mathematical modeling through the use of computer technology began to reveal the complexity of systems,<sup>28</sup> allowing scientists “to discover order beneath the seeming chaos.”<sup>29</sup> Such an approach provided systems scientists a framework to help explain patterns in nature but also to generate alternative methods to evaluate, reject, and replace

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24. JOHN H. MILLER & SCOTT E. PAGE, *COMPLEX ADAPTIVE SYSTEMS: AN INTRODUCTION TO COMPUTATIONAL MODELS OF SOCIAL LIFE* 9 (2007). Thus “work is needed on distinguishing the complex . . . from the just complicated in the presence of many possible explanatory models and imperfect data.” Nicholas W. Watkins & Mervyn P. Freeman, *Natural Complexity*, 320 *SCIENCE* 323, 324 (2008).

25. CAPRA & LUISI, *supra* note 18, § 4.1.

26. *Id.*; see also Robin Kundis Craig, *Resilience Theory and Wicked Problems*, 73 *VAND. L. REV.* 1733 (2020) (noting that Rittel and Webber’s conceptualization of wicked problems, while focused on a more linear scientific understanding of natural systems, takes a step toward systems thinking by acknowledging the open and interacting nature of natural systems).

27. VON BERTALANFFY, *supra* note 6, at 39–41; see also CAPRA & LUISI, *supra* note 18, § 5.2. The work notes that the development by Nobel laureate Ilya Prigogine of an approach to complex mathematics in application to non-equilibrium thermodynamics of chemical systems allowed this advance. *Id.* Prigogine was able to show that while non-equilibrium, open systems tended toward increasing order and complexity, the dissipation of energy and matter in that process had an overall result of increasing entropy, thus maintaining consistency with the second law of thermodynamics. *Id.*

28. CAPRA & LUISI, *supra* note 18, § 6.

29. *Id.* § 6.3.1, at 109.

theories within the systems paradigm. Hence, complexity theory was developed to account for increasing numeric complexity in systems (i.e., number of components or variables and complexity attributed to nonlinear relationships among components).<sup>30</sup>

*Resilience theory* was first proposed by C.S. (Buzz) Holling,<sup>31</sup> who applied systems theory to the field of ecology.<sup>32</sup> Holling developed new and novel mathematical models to describe predation in the 1960s. He discovered that simple predator/prey models generated oscillations around a stable equilibrium for a wide range of organisms and ecosystems. Such systems may fluctuate substantially (generate dynamic behavior) around an equilibrium due to nonlinear relationships and feedbacks among components. By the 1970s he began creating more complex models to include other factors such as more predators, external disturbances (such as disease), or changes in food availability or nutrition.<sup>33</sup> As he increased the complexity of the model system, he noted unexpected outcomes. His results indicated that changes in system controls, both external (food availability) and internal (feedbacks), would result in different system configurations. In other words, a disturbance to a system may cause that system to cross a threshold into a qualitatively different regime or state characterized by different structures and functions, which in turn are maintained by feedbacks. He called this phenomenon a system “flip” and used the word resilience to describe the process that mediates the transition or flip.<sup>34</sup> Once a threshold is crossed, a system may or may not return to the prior

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30. *Id.* § 6 (noting that complexity theory is also referred to as “nonlinear systems theory” and “dynamical systems theory,” and that chaos theory and fractal geometry are branches of complexity theory). Importantly, Capra and Luisi are quick to note that a mathematical theory is not the same as a scientific theory, which is developed through observation and experimentation, but instead represents a means of qualitatively depicting patterns. *Id.* As will be discussed, resilience theory developed first through mathematical modeling (i.e., complexity theory) and grew as empirical evidence supported the patterns discovered. An excellent example of this process of modeling followed by empirical proof in the popular press is the recent picture of a black hole predicted by Einstein’s mathematical theory of relativity. Shep Doeleman, *Focus on the First Event Horizon Telescope Results*, IOP: IOPSCIENCE (Apr. 2019), [https://iopscience.iop.org/journal/2041-8205/page/Focus\\_on\\_EHT](https://iopscience.iop.org/journal/2041-8205/page/Focus_on_EHT) [<https://perma.cc/T5H2-4FGF>].

31. Holling, *supra* note 20, at 1–23; Lance H. Gunderson, C.S. Holling, Lowell Pritchard Jr. & Garry D. Peterson, *Resilience of Large-Scale Resource Systems*, in *RESILIENCE AND THE BEHAVIOR OF LARGE-SCALE SYSTEMS* 3, 4 (Lance H. Gunderson & Lowell Pritchard Jr. eds., 2002).

32. Ecology arose as a separate field of study in the late nineteenth century when biologists began to study the relations among living organisms and their environment. CAPRA & LUISI, *supra* note 18, § 4.1.5.

33. Holling, *supra* note 20, at 1–23 (discussing and illustrating some of those more complex models); Carl Folke, *Resilience: The Emergence of a Perspective for Social–Ecological Systems Analyses*, 16 *GLOB. ENV’T CHANGE* 253, 254 (2006) (quoting C.S. Holling).

34. Holling, *supra* note 20, at 15–19.

state.<sup>35</sup> This recognition of nonlinear behavior became a key component of resilience theory, as described by Holling:

Once discovered it was obvious that conditions for multi-stable states were inevitable. And that, being inevitable, there were huge consequences for theory and practice. Single equilibria and global stability had made ecology focus on near equilibria behavior, fixed carrying capacity with a goal of minimizing variability. The multi-stable state reality opened an entirely different focus on behavior far from equilibrium and on stability boundaries. High variability became an attribute to maintain existence and learning. Surprise and inherent unpredictability was the inevitable consequence for ecological systems.<sup>36</sup>

The propositions of Holling's resilience theory made in the early 1970s were debated in the ecological literature; the main critique being a lack of empirical support. By the 1990s, however, empirical evidence of regime shifts in ecosystems such as coral reefs, lakes, and grasslands, all of which had been subjected to extensive human actions, was mounting. Evidence of the existence of multiple stable states in ecosystems is now substantial.<sup>37</sup>

Holling's work shares many of the attributes and relies on the same developments in mathematics and computing as complexity theory and, as such, enabled the expansion and testing of resilience theory in other disciplinary fields (such as economics, anthropology, and political science) that focus on various ways humans interact with ecosystems.<sup>38</sup> Similar to systems thinking, resilience theory focuses on

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35. *Id.*; C.S. Holling, *Engineering Resilience Versus Ecological Resilience*, in ENGINEERING WITHIN ECOLOGICAL CONSTRAINTS 31, 31–32 (Peter C. Schulze ed., 1996); Marten Scheffer, Steve Carpenter, Jonathan A. Foley, Carl Folke & Brian Walker, *Catastrophic Shifts in Ecosystems*, 413 NATURE 591, 591 (2001); PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS (Lance H. Gunderson & C.S. Holling eds., 2002) [hereinafter PANARCHY]; Brian Walker, C.S. Holling, Stephen R. Carpenter & Ann Kinzig, *Resilience, Adaptability and Transformability in Social–Ecological Systems*, 9 ECOLOGY & SOC'Y, no. 2, 2004, at 1, 2, <https://www.ecologyand-society.org/vol9/iss2/art5/print.pdf> [<https://perma.cc/TAM4-KR24>]; BRIAN WALKER & DAVID SALT, RESILIENCE THINKING: SUSTAINING ECOSYSTEMS AND PEOPLE IN A CHANGING WORLD 58 (2006).

36. Folke, *supra* note 33, at 254 (quoting C.S. Holling).

37. *Id.* at 256–57.

38. See Simon A. Levin, Scott Barrett, Sara Aniyar, William Baumol, Christopher Bliss, Bert Bolin, Partha Dasgupta, Paul Ehrlich, Carl Folke, Ing-Marie Gren, C.S. Holling, AnnMari Jansson, Bengt-Owe Jansson, Karl-Göran Mäler, Dan Martin, Charles Perrings & Eytan Sheshinski, *Resilience in Natural and Socioeconomic Systems*, 3 ENV'T & DEV. ECONS. 222, 225–36 (1998) (applying resilience theory to economic systems). It is interesting to note that in a 1999 book, Simon Levin used complex adaptive systems theory to analyze and inform ecosystem management and viewed adaptive management as an appropriate response to the unpredictable behavior of ecosystems, without acknowledging the link between Holling's alternative ecological regimes and adaptive management. See SIMON A. LEVIN, FRAGILE DOMINION: COMPLEXITY AND THE COMMONS 199 (1999). Levin's work equates the term "resilience" with "resistance" rather than Holling's recognition that adaptive capacity and resistance play a role in maintaining a particular state, and his inclusion of the existence of alternative stable states and the possibility of regime shift as part of resilience theory. *Id.* at 173 n.58. While both the work of Holling and of Levin inform this article, it will rely on the definitions and the line of literature stemming from Holling,

the processes controlling interaction of system components as opposed to the components themselves. Holling further emphasized the difference between “engineering resilience,” focused on the resistance of a static system to change and its return time to an equilibrium state following a disturbance,<sup>39</sup> and “ecological resilience,” focused on “the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks.”<sup>40</sup> Importantly, ecological resilience theory is an application of complexity theory and shares its understanding of the emergent properties associated with the interaction of system components.

### *B. Complexity as Context for Governance*

Although their article is famous for its description of wicked problems as a category, Rittel and Webber developed the category to explain why governance at the time in the United States and other Western democratic nations was undergoing a transition from relying on rationalist expertise for problem solving to a far more pluralistic environment in which social goals and problem definition were highly contested.<sup>41</sup> Central to their theme was the growing complexity of social problems, which in their view were increasingly operating in “large and interconnected networks of systems.”<sup>42</sup> The governance challenge they identified from this growing complexity was that “any solution, after being implemented, will generate waves of consequences,” some of which could “yield utterly undesirable repercussions which outweigh the intended advantages” of the solution.<sup>43</sup> In such an environment, social problems are no longer solved—they are, at best, managed well.

Although Rittel and Webber were writing before complexity science developed the model of complex systems, their conception of wicked problems captures many of its themes, and scholarship on wicked problems theory has increasingly turned to complexity science

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*supra* note 20, to understand resilience theory in ecology and consider its implications for governance.

39. Holling, *supra* note 35, at 33.

40. Walker et al., *supra* note 35, at 2; *see also* Holling, *supra* note 20 (introducing the concept of ecological resilience); Lance H. Gunderson, *Ecological Resilience—in Theory and Application*, 31 ANN. REV. ECOLOGY, EVOLUTION & SYSTEMATICS 425 (2000) (discussing ecological resilience); PANARCHY, *supra* note 35 (same); Gunderson et al., *supra* note 31 (same); Lance Gunderson & Stephen S. Light, *Adaptive Management and Adaptive Governance in the Everglades Ecosystem*, 39 POL’Y SCIS. 323, 324 (2006) (same); Folke, *supra* note 33, at 253–55 (same); WALKER & SALT, *supra* note 35, at 1 (same).

41. Rittel & Webber, *supra* note 1, at 155–59.

42. *Id.* at 159.

43. *Id.* at 163.

as an important source of understanding.<sup>44</sup> Indeed, if anything, social problems have only grown more complex, at faster rates, since Rittel and Webber developed the concept of wicked problems. Hence, at this time when governance confronts accelerating change across geographical scales and different social-ecological systems, seven related features of complex systems are driving forces behind modern wicked problems: (1) self-organization; (2) emergence; (3) networks; (4) feedback; (5) nonlinearity and tipping points; (6) cross-scale interactions; and (7) uncertainty.<sup>45</sup> Relying on the literature on complexity theory and resilience, we expand on these seven features to demonstrate the challenges they present for governance.

(1) *Self-organization.* Structures and functions in complex systems arise or emerge through a process called self-organization.<sup>46</sup> One of the mysteries of self-organization is that systems can develop towards stable regimes without an identified designer or controller. Self-organization leads to ecosystems characterized as forests or physical systems such as tropical cyclones.<sup>47</sup>

Markets are good examples of self-organization within a system of governance. The combined results of many individual decisions to buy and sell goods and services without external coordination leads to the emergence of markets, which generate economic stability as a result of the interaction between supply and demand, as well as efficient distribution of capital over large geographic scales.<sup>48</sup> Nobel Laureate Elinor Ostrom used the term “self-organization” to describe the coming together of individuals in a community to solve a common problem of allocation of common pool resources without a regulatory mandate from government.<sup>49</sup> Indeed, “[o]ne of the most significant challenges for adaptive governance is to develop social contexts and legal structures

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44. Brian W. Head, *Forty Years of Wicked Problems Literature: Forging Closer Links to Policy Studies*, 38 POL’Y & SOC’Y 180, 191 (2019); Brian W. Head & John Alford, *Wicked Problems: Implications for Public Policy and Management*, 47 ADMIN. & SOC’Y 711, 724 (2015).

45. See J.B. Ruhl & Daniel Martin Katz, *Measuring, Monitoring, and Managing Legal Complexity*, 101 IOWA L. REV. 191, 229–31 (2015) (focusing on emergence, feedback and self-organization as attributes of complexity recognized in legal systems).

46. CAPRA & LUISI, *supra* note 18, § 5.3.5; Gunderson, *supra* note 40, at 430; Holling, *supra* note 20.

47. See CAPRA & LUISI, *supra* note 18, § 8.1.1 (defining self-organization as processes that occur spontaneously without an external controller, and providing examples of several biological processes that are self-organizing).

48. See ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS (J.M. Dent & Sons, Ltd. 1910) (1776) (arguing that free (i.e. unregulated) markets will provide greater prosperity).

49. ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 1 (1990); Fabien Locher, *Historicizing Elinor Ostrom: Urban Politics, International Development and Expertise in the U.S. Context (1970-1990)*, 19 THEORETICAL INQUIRIES L. 533, 543 (2018).

that can support adaptation without stifling the potential for self-organization.”<sup>50</sup>

(2) *Emergence*. Emergence describes the presence of novel system properties that arise from interactions (i.e., self-organization) among the components of a system.<sup>51</sup> In complexity theory, emergence corresponds to a sudden appearance of order in a system following a period of instability<sup>52</sup> and is of critical importance in the scientific understanding of life.<sup>53</sup> Emergence is the phenomenon referred to by the phrase: “[T]he whole is greater [or other] than the sum of the parts,”<sup>54</sup> meaning that interacting components within the system produce patterns or regularities that cannot be understood through study of the components.

Importantly, emergence is context specific. Similar systems in a slightly different setting or with a slightly different mix of components may show different emergent properties when disturbed. While patterns in similar systems repeat, and the study of one ecosystem may inform the study of another, the exact nature of a system, its capacity to adapt to change, and its existence in one or another stable state depends on its surroundings and history.<sup>55</sup>

Emergence is used in the context of governance to describe the networks and solutions that arise from self-organization to respond to large-scale problems in the absence of any mandate to do so.<sup>56</sup> Examples include watershed organizations that form to restore habitat or cities that come together to take ambitious action to address climate change, with no governmental authority requiring either action. The fact that

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50. Mónica Cavalcanti Sá de Abreu & Raphael de Jesus Campos de Andrade, *Dealing with Wicked Problems in Socio-ecological Systems Affected by Industrial Disasters: A Framework for Collaborative and Adaptive Governance*, 694 SCI. TOTAL ENV'T, Dec. 1, 2019, at 6, <https://doi.org/10.1016/j.scitotenv.2019.133700> [<https://perma.cc/NEG8-R9TG>] (PDF download available at URL provided).

51. CAPRA & LUISI, *supra* note 18, §§ 4.1.2, 8.2.1 (“C.D. Broad (1887–1971) coined the term ‘emergent properties’ for those properties that emerge at a certain level of complexity but do not exist at lower levels.”); Brian C. Chaffin & Lance H. Gunderson, *Emergence, Institutionalization and Renewal: Rhythms of Adaptive Governance in Complex Social-Ecological Systems*, 165 J. ENV'T MGMT. 81, 83–84 (2016).

52. CAPRA & LUISI, *supra* note 18, § 6.3.3.

53. *Id.* § 8.3.1.

54. Aristotle is attributed with this observation, although his statement in *Metaphysics* translates to “the totality is not, as it were, a mere heap, but the whole is something beside the parts.” ARISTOTLE, *METAPHYSICS*, bk. VIII, pt. 6 (W.D. Ross trans.) (350 B.C.E.). Kurt Koffka, the architect of gestalt theory, is also attributed with this statement. See M.R. Harrower-Erickson, *Kurt Koffka: 1886-1941*, 55 AM. J. PSYCH. 278 (1942) (discussing the life and works of Kurt Koffka).

55. See LEVIN, *supra* note 38, at 57–80.

56. Brian C. Chaffin, Hannah Gosnell & Barbara A. Cosens, *A Decade of Adaptive Governance Scholarship: Synthesis and Future Directions*, 19 ECOLOGY & SOC'Y, no. 3, 2014, at 1–2, <http://dx.doi.org/10.5751/ES-06824-190356> [<https://perma.cc/X5EG-2FBB>] (PDF download available at URL provided).

emergence is context specific renders it impossible to design a government program for every complex problem.

In governance of complex problems, such contextualization cautions against panaceas.<sup>57</sup> A deep understanding of a complex problem and its setting, the inclusion of local knowledge and perspective, and a tailoring of governance to that context are required yet are impossible to achieve through government programs alone. In particular, when humans are involved, issues of power and agency enter into the context, further adding to the complexity challenge for governance.

(3) *Networks*. A network is the pattern or structure of components that are linked across spatial scales.<sup>58</sup> Networks mediate dynamic exchange among the components of a system and can include the flow of energy, matter, information, ideas, or currency.

Networks have been popularized to describe the self-organization of society through social media, but they are also present in ecosystems and systems of governance. A classic example of networks in U.S. government is the relationship between the three branches of government or between state and federal government. So prevalent are networks in legal systems that scholars have begun to develop methodologies to map them.<sup>59</sup>

(4) *Feedbacks*. Feedbacks occur when system components influence each other. Feedbacks are generated by causal loops that return to the source and provide a critical concept for understanding system dynamics such as self-regulation and learning.<sup>60</sup> Feedback can be negative or positive. Negative feedback leads to control and stability (stable air temperature in a modern building is a result of negative feedbacks, as is the human body temperature). Positive (or self-reinforcing) feedback (such as population growth) may cause a small change to result in large effects and can lead to rapid transitions in the

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57. See Elinor Ostrom, *A Diagnostic Approach for Going Beyond Panaceas*, 104 PROC. NAT'L ACAD. SCI. 15181, 15181 (2007) (challenging universal solutions to resource overuse or destruction and describing more complex methodologies for developing solutions).

58. CAPRA & LUISI, *supra* note 18, § 4.1.5.

59. See Mattias Derlén & Johan Lindholm, *Goodbye van Gend en Loos, Hello Bosman? Using Network Analysis to Measure the Importance of Individual CJEU Judgments*, 20 EUR. L. REV. 667 (2014) (applying network analysis to legal judgments by the Court of Justice of the European Union); Marios Koniaris, Ioannis Anagnostopoulos & Yannis Vassiliou, *Network Analysis in the Legal Domain: A Complex Model for European Union Legal Sources*, 6 J. COMPLEX NETWORKS 243 (2018) (applying network analysis to EU legal sources).

60. CAPRA & LUISI, *supra* note 18, § 5.3.1 (noting that Norbert Wiener, who was credited with recognizing the causal connections that are integral to feedback loops, also recognized their importance in social systems (NORBERT WIENER, *CYBERNETICS: OR CONTROL AND COMMUNICATION IN THE ANIMAL AND THE MACHINE* (1st ed. 1948)); CAPRA & LUISI, *supra* note 18, § 5.3.5 (discussing self-organization)).



state of a system.<sup>61</sup> Positive feedback results in instability, as illustrated by radioactive decay.

Feedback intentionally occurs in legal systems and political systems. Scholars have described the structure of checks and balances among branches of government as creating stabilizing feedback loops.<sup>62</sup> Interestingly, perception of governmental action can create a positive feedback that magnifies the public response to a political action for good or for bad.<sup>63</sup> Knowledge from governance experiments is something governments could compile, disseminate, and use to distribute resources to facilitate the spread of successful innovation.

(5) *Nonlinearity and tipping points.* Nonlinearity refers to system interactions and behavior that are neither continuous nor linear (such as progress through similar, successive steps). Nonlinear relationships can lead to abrupt changes in a system when it reaches a threshold.<sup>64</sup> In popular language, this abrupt change is referred to as a phase change, regime shift, or tipping point.<sup>65</sup> Examples are as simple as the transition of water from ice to liquid to steam and as complicated as governmental regime shift in the wake of revolution. The study and mathematical depiction of complexity illustrates that it may be more difficult to return to the former state once a threshold is crossed (in fact, some shifts may be irreversible).<sup>66</sup> Empirical studies also suggest that thresholds may be very difficult to identify until crossed.<sup>67</sup>

The possibility of nonlinear behavior is of particular importance in the governance of social-ecological systems facing climate change. The possibility of surprise from nonlinearity presents challenges for the structural orientation of governance systems. For example, top-down, centralized government programs may favor engineering resilience over ecological resilience and thus be more subject to rapid transformation. Governance through multiple types and scales of institutions may foster innovation. Breathing space for adaptation of environmental systems optimized for key services may be essential to

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61. CAPRA & LUISI, *supra* note 18, § 6.2.2; *see also* PANARCHY, *supra* note 35.

62. GEORGE P. RICHARDSON, *FEEDBACK THOUGHT IN SOCIAL SCIENCE AND SYSTEMS THEORY* 64–66 (1991).

63. *Id.* at 212.

64. Holling, *supra* note 20, at 3–6; Gunderson, *supra* note 40, at 431–32.

65. *See* MALCOLM GLADWELL, *THE TIPPING POINT: HOW LITTLE THINGS CAN MAKE A BIG DIFFERENCE* (2000) (as the title suggests, this book describes the “tipping point” of various trends, at which a small shift in a system leads to abrupt and widespread changes).

66. Scheffer et al., *supra* note 35, at 593; *see also* *Thresholds Database*, RESILIENCE ALL., <https://www.resalliance.org/thresholds-db> (last visited Sept. 26, 2020) [<https://perma.cc/3QW2-498Q>] (compiling a directory of thresholds and regime shifts in ecological and linked social-ecological systems).

67. *See* Scheffer et al., *supra* note 35, at 591 (noting that catastrophic shifts are typically unannounced and signs of an upcoming change are difficult to obtain).

avoiding societally undesirable tipping points.<sup>68</sup> Capacity to transform may be essential if tipping points are unavoidable and require erosion of system resilience.<sup>69</sup> The preference of legal and economic systems for stasis means that government leadership and resources will be essential in any necessary transformation.<sup>70</sup>

(6) *Cross-scale interactions.* As Rittel and Webber recognized through their reference to “large and interconnected networks of systems,”<sup>71</sup> complex systems are generally nested within a system of coevolving systems—a system of systems. Zooming in on the global economy, we find regional economies, such as the United States or the European Union (“EU”), state economies, such as Idaho or Finland, and local economies within states. Each level is a complex system, but the levels also impact one another. Changes in the global economy impact the regional, state, and local economies. Similarly, the nested lower-level economic systems contribute to and bring about the dynamics of the global economy. Moreover, all these different levels are connected to various biophysical and social systems, including the law. For example, the legal system regulates the finance system, but changes in the finance system may then require changes in the legal system. Thus, a holistic approach or method is needed to understand the behavior of a system in its specific context. Understanding of the systems nested within the system of interest, and those at a higher level than the system of interest, is needed to appreciate the network effects of intervening in any one component of the network.

For governance, this nesting of systems could become an avenue to make room for small-scale innovation while providing stability at higher levels. A typical example would be to set legally binding goals or general rules at the federal level and allow a margin of discretion for state or local level actors in implementing measures to reach the goals. Nevertheless, the complex emergent properties of nested systems compound the problem of transferability of solutions.

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68. Daniel A. DeCaro, Brian C. Chaffin, Edella Schlager, Ahjond S. Garmestani & J.B. Ruhl, *Theory and Research to Study the Legal and Institutional Foundations of Adaptive Governance*, in PRACTICAL PANARCHY, *supra* note 9, at 269, 273–74.

69. See Brian C. Chaffin, Ahjond S. Garmestani, Lance H. Gunderson, Melinda Harm Benson, David G. Angeler, Craig Anthony (Tony) Arnold, Barbara Cosens, Robin Kundis Craig, J.B. Ruhl & Craig R. Allen, *Transformative Environmental Governance*, 41 ANN. REV. ENV'T & RES. 399, 417 (2016) (“[The need for] [t]ransformative governance arises . . . when a social-ecological regime shift is eminent or the need for a regime shift (e.g., a severely degraded SES) is apparent to provide for human and ecosystem wellbeing.”).

70. See *id.* at 410–11 (highlighting the important roles that the law, formal institutions, and government structures play in transformative governance).

71. Rittel & Webber, *supra* note 1, at 159.

(7) *Uncertainty*. The consequence of self-organization, emergence, networks, feedback, nonlinear tipping points, and cross-scale interactions is the hallmark feature of complex systems—uncertainty.<sup>72</sup> Uncertainty is particularly prevalent in dynamic systems subject to external disturbances, such as the current COVID-19 pandemic and unintended consequences related to global climate change.

Social systems seek stability from governance for reasons spanning security for investment and the knowledge that society may live free of conflict.<sup>73</sup> Yet this desirable goal of stability produces an unyielding response to change.<sup>74</sup> The understanding that uncertainty in a complex system is an aspect of emergence reveals the futility of an approach to governance that maintains the status quo while uncertainty is reduced through further study. Rather, maintaining the status quo is itself a management decision with consequences in the face of change.

From its origins in biology and its development in math and physics, complexity theory rapidly penetrated other sciences focused on systems, such as ecology and brain science, as well as social sciences including economics, management, anthropology, and even law.<sup>75</sup> All of these disciplines study complex systems. Law is charged with managing other complex systems, including finance, health care, and human interaction with the environment, and is itself a complex system.<sup>76</sup> We

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72. See Holling, *supra* note 20, at 17–19 (noting the presence of uncertainty in both external sources of system disturbance and in system response to that disturbance); Gunderson, *supra* note 40, at 432–34 (noting that unpredictability and uncertainty are inherent in complex ecological systems).

73. See Robin Kundis Craig, Ahjond S. Garmestani, Craig R. Allen, Craig Anthony (Tony) Arnold, Hannah Birgé, Daniel A. DeCaro, Alexander K. Fremier, Hannah Gosnell & Edella Schlager, *Balancing Stability and Flexibility in Adaptive Governance: An Analysis of Tools Available in U.S. Environmental Law*, 22 *ECOLOGY & SOC'Y*, no. 2, 2017, at 1 [hereinafter Craig et al., *Balancing Stability and Flexibility*], <https://doi.org/10.5751/ES-08983-220203> [<https://perma.cc/NF6S-58HC>] (PDF download available at URL provided) (addressing the virtues of stability in governance); Robin Kundis Craig, Ahjond S. Garmestani, Craig R. Allen, Craig Anthony (Tony) Arnold, Hannah Birgé, Daniel DeCaro & Hannah Gosnell, *Stability and Flexibility in the Emergence of Adaptive Water Governance*, in *PRACTICAL PANARCHY*, *supra* note 9, at 167, 167–82 [hereinafter Craig et al., *Stability and Flexibility*] (same).

74. See, e.g., Lance H. Gunderson, Ahjond Garmestani, Keith W. Rizzardi, J.B. Ruhl & Alfred Light, *Escaping a Rigidity Trap: Governance and Adaptive Capacity to Climate Change in the Everglades Social Ecological System*, 51 *IDAHO L. REV.* 127 (2014) [hereinafter Gunderson et al., *Escaping a Rigidity Trap*] (discussing how the water management system of the Everglades has changed and adapted over time); Lance Gunderson, Ahjond S. Garmestani, Keith W. Rizzardi, J.B. Ruhl & Alfred R. Light, *Social, Legal, and Ecological Capacity for Adaptation and Transformation in the Everglades*, in *PRACTICAL PANARCHY*, *supra* note 9, at 65, 65–82 [hereinafter Gunderson et al., *Social, Legal, and Ecological Capacity*] (same).

75. Ruhl & Katz, *supra* note 45, at 198–99.

76. J.B. Ruhl, Daniel Martin Katz & Michael J. Bommarito II, *Harnessing Legal Complexity: Bring Tools of Complexity Science to Bear on Improving Law*, 355 *SCIENCE* 1377, 1377 (2017).

2020]

*ENABLING ADAPTIVE GOVERNANCE*

1705

make the same observation about governance more broadly—governance both is a complex system and manages complex human and coupled social-ecological systems. We will return to the seven features of complex systems in the context of adaptive governance, but first, it is important to understand how and why governance evolves.

## II. GOVERNANCE TRENDS WITH INCREASING COMPLEXITY

While the current rate of change is unprecedented, democratic societies have navigated change through transformations in society and governance in the past. This history is important in identifying patterns in governance evolution as well as the role of government in periodic transformations. From a multidisciplinary review of governance literature: “Governance may be defined as organized efforts to manage the course of events in a social system.”<sup>77</sup> It is considered a broader term than government, with government forming a subset: “Whereas government refers to political institutions, governance refers to processes of rule wherever they occur.”<sup>78</sup> Central to all definitions of governance is the focus on the process of development of formal and informal rules that “define[] rights and responsibilities of members facing common social problems.”<sup>79</sup> “The term governance encompasses not only government but the relationship between government and society, including the means through which private actors, markets, and even interest-based networks influence policy decisions and self-organize to mediate their own behavior.”<sup>80</sup> We turn to this rich understanding of governance from the policy sciences before seeking common ground between these insights and the characterization of similar phenomena by resilience scholars.

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77. Burriss et al., *supra* note 10, at 3.

78. BEVIR, GOV. INTRO, *supra* note 9, at 3; *see also* BEVIR, THEORY GOV., *supra* note 9, at 17. For the definition used in the AWG Project *see* Cosens & Gunderson, *supra* note 9, at 5 (“Governance refers to the means through which collective goals are chosen, decisions are made, and action is taken to achieve the chosen goals.” (first citing ROGERS & HALL, *supra* note 9; then citing GOVERNANCE FOR THE ENVIRONMENT, *supra* note 9; and then citing UNITED NATIONS SYS. TASK TEAM, *supra* note 9)).

79. Myungsuk Lee, *Conceptualizing the New Governance: A New Institution of Social Coordination* 4 (May 3, 2003), <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.202.1474> [<https://perma.cc/92VH-P378>] (PDF download available at URL provided).

80. Cosens & Gunderson, *supra* note 9, at 5; *see also* VANDENBERGH & GILLIGAN, *supra* note 10 (discussing the rise of private governance in response of the failure of government to address climate change).

*A. Coevolving Society and Governance*

Dorf and Sabel explain major changes in the U.S. federal government as the reconciliation (“synthesis” in their words) of the two conflicting views of democracy that Madison saw as imbedded in the Constitution—that is, that democracy is both deliberative and calculative.<sup>81</sup> Under their framing, this need for reconciliation forces evolution in government in application to an evolving society.<sup>82</sup> Thus, this tension imbedded in the Constitution, if reconciled in application to an increasingly complex society, will strike the appropriate balance between self-organization and intentional government intervention. This Article focuses on the need to make room for greater distributed self-organization in the face of increasing complexity while at the same time enhancing the capacity of government to facilitate and steer these efforts in a manner that reflects the public good. In doing so, we find the review of past transformations in society and governance by Dorf and Sabel extremely valuable. It reveals patterns in the coevolution of society and governance and moments of rapid, nonlinear change in which transformation without revolution took place.<sup>83</sup>

The society governed in the initial century of the U.S. Constitution, similar to other Western democracies of the time, was largely agrarian. This dominance of local economies and homogeneity in their pursuit allowed a high level of self-governance.<sup>84</sup> In those circumstances, society had the capacity to be largely self-governing and thus deliberative in the process of local decisionmaking. Hierarchy based on land ownership led to varying degrees of inequity in different democratic systems but also created a private governance structure with safety nets for its members. Competition among the three branches of government, among states and the federal government due

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81. Michael C. Dorf & Charles F. Sabel, *A Constitution of Democratic Experimentalism*, 98 COLUM. L. REV. 267, 267 (1998). While the article by Dorf & Sabel focuses on the U.S. experience, this paper will turn to sources considering a broader geographic scope when analyzing new and adaptive governance.

82. *Id.* at 275.

83. Also, constitutions evolve. ALEXANDER SOMEK, *THE COSMOPOLITAN CONSTITUTION* 1–35 (2014). Somek argues that globally there have been three major phases of constitutional development: constitutionalism 1.0 (constitution protecting civil liberties and emphasizing the negative obligations of government); constitutionalism 2.0 (constitution protecting human rights, such as dignity, and emphasizing the positive obligations of government); and constitutionalism 3.0 (age of pluralism in which constitutional authority is spread among institutions at multiple levels of governance). *Id.* at 36–133, 176–243. Constitutionalism 3.0 is in interesting parallel with societal decisionmaking moving from government to broader understanding of governance. Both developments describe the diminishing role of government facing complexity.

84. See Dorf & Sabel, *supra* note 81, at 276 (noting that the Madisonian synthesis was premised on the understanding that early American society was locally self-governing with a limited role for federal government).

2020]

*ENABLING ADAPTIVE GOVERNANCE*

1707

to federalism, and between the two houses of the legislature resulted in a limited government that leaves space for local self-governance.<sup>85</sup>

The Industrial Revolution disrupted this local capacity for self-determination across Western democracies.<sup>86</sup> Economic ties were no longer local.<sup>87</sup> Unrestrained market power by a new form of economic organization created a working class without the former community safety net for old age or sickness and with no control over its own wages.<sup>88</sup> The rise of industry also corresponded to widespread environmental degradation that came about as a result of increasing agricultural and economic activity, along with increased population growth.<sup>89</sup> In the United States and elsewhere, government intervention resulted in the vast expansion of technocratic agencies that were delegated decisionmaking power within legislatively established bounds.<sup>90</sup> Dorf and Sabel argue that the response was entirely consistent with an increase in societal complexity.<sup>91</sup> The use of bureaucracies with technical expertise to both enable and curb the power of large economic organizations that crossed local and state boundaries filled the gap in the capacity of local self-organization to govern.<sup>92</sup> Attention to process assured fair and uniform application of rules across vast areas.

By the 1970s, the complexity of social problems and their context-specific emergence began to exceed the capacity for a governance system based on uniform process and solution.<sup>93</sup> Indeed, this trend is precisely the governance challenge that Rittel and Webber identified in their theory of wicked problems.<sup>94</sup> Communities and individuals were left without solutions for local issues.<sup>95</sup> Dorf and Sabel argue that government did not respond to that complexity.<sup>96</sup> Instead, it vacillated between reforms that would constrain agencies through

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85. *Id.*; see also SOMEK, *supra* note 83, at 1–9 (describing this as constitutionalism 1.0 protecting civil liberties).

86. Dorf & Sabel, *supra* note 81, at 276.

87. *Id.*

88. *Id.* at 276–77.

89. RICHARD J. LAZARUS, *THE MAKING OF ENVIRONMENTAL LAW* 9 (2004).

90. Dorf & Sabel, *supra* note 81, at 277.

91. *Id.*

92. See SOMEK, *supra* note 83, at 11. One aspect of constitutionalism 2.0 is government assuming a more paternalistic role in securing rights, such as right to a clean environment, and starts exerting control over free markets. *Id.*

93. Dorf & Sabel, *supra* note 81, at 278.

94. Rittel & Webber, *supra* note 1, at 155–56; see also J.B. Ruhl & James Salzman, *Governing Wicked Problems*, 73 *VAND. L. REV.* 1561 (2020).

95. Dorf & Sabel, *supra* note 81, at 280–81.

96. *Id.* at 279–82.

oversight and judicial review<sup>97</sup> and reforms that would result in retreat to the concept of limited government that prevailed during the era of agrarian economies.<sup>98</sup>

Government reform, led by the neoliberal movement, accelerated in the 1980s in many parts of the world and focused on reducing the role of the state through marketization (i.e., privatization of public services as well as the use of market features such as competition and price mechanisms in regulation or the continued public delivery of services<sup>99</sup>) and deregulation (lifting of government regulation of private activity<sup>100</sup>). These neoliberal reforms began in the United States with the Reagan Presidency (1981–1989), in the U.K. with the term of Prime Minister Thatcher (1979–1990),<sup>101</sup> and via the World Bank in that same era in parts of the Global South.<sup>102</sup> It was considered a response to the failures of an unwieldy bureaucracy caused by increasing diversity in complex problems that exceeded the capacity of centralized bureaucracy and its uniform process of policy implementation.<sup>103</sup> Bureaucracies were considered to have become increasingly inefficient at providing public services<sup>104</sup> and unresponsive to the varied demands of citizens.<sup>105</sup>

This nostalgia for a time of limited government that worked for a self-governing agrarian society<sup>106</sup> failed in the absence of an actual societal return to those conditions. The reform experiment in the United States retained the benefits of legal recognition of the corporate form of organization and corporate personhood and their reach across jurisdictional boundaries while limiting means for redress of any harm from their actions.<sup>107</sup> This juxtaposition of the old and the new has led to a perceived loss of legitimacy in government and the electoral process. Powerful corporate actors have used the relaxation of

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97. *Id.* at 279.

98. *Id.* at 281–82.

99. BEVIR, KEY CONCEPTS, *supra* note 9, at 127–28.

100. *Id.* at 171–72.

101. Shalanda H. Baker, *Adaptive Law in the Anthropocene*, 90 CHI-KENT L. REV. 563, 573 (2015).

102. *Id.*; BEVIR, KEY CONCEPTS, *supra* note 9, at 129; *Managing Development: The Governance Dimension*, WORLD BANK 10, 12, 34, 36 (Aug. 29, 1991), <http://documents.worldbank.org/curated/en/884111468134710535/pdf/34899.pdf> [<https://perma.cc/Z2EB-64AL>]; CARL J. BAUER, SIREN SONG: CHILEAN WATER LAW AS A MODEL FOR INTERNATIONAL REFORM 4 (2004) (discussing the World Bank's role in promoting neoliberal, free market policies in Latin America).

103. Dorf & Sabel, *supra* note 81, at 278–79.

104. BEVIR, THEORY GOV., *supra* note 9, at 162.

105. BEVIR, KEY CONCEPTS, *supra* note 9, at 128–29.

106. Dorf & Sabel, *supra* note 81, at 276, 281.

107. *Id.* at 280–81.

regulation to serve their own needs at the expense of others.<sup>108</sup> The market approach in the Global South compounded the problems of weak government,<sup>109</sup> increased debt, led to unsustainable use of resources,<sup>110</sup> and led to the further marginalization of indigenous and poor communities in the competition for resources.<sup>111</sup>

While the human exercise of agency, power, and empathy determines the chosen path, complexity theory informs both the failures of bureaucracy and of neoliberal reform. By viewing law as itself a complex system, oversimplified approaches to governance such as centralized command and control, or wholesale efforts at marketization, are bound to produce unintended consequences in complex systems that display self-organization and emergence.<sup>112</sup> Viewing governance of a rapidly changing society as itself a wicked problem highlights the difficulty of isolating cause and effect in an interconnected system and thus the impossibility of governance solely by design.<sup>113</sup> Rather than throw out the beneficial aspects of regulation in certain circumstances and markets in others or design an entirely new governmental approach, it is time to take a step back and ask: How is this complex system of society and governance responding to these problems? What we see is the emergence of new governance in economic systems in the United States and the EU in the form of public-private networks, greater citizen involvement,<sup>114</sup> and the emergence of adaptive governance with similar attributes in environmental governance.<sup>115</sup> Both show promise. Both have problems.

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108. Burris et al., *supra* note 10, at 36.

109. BEVIR, KEY CONCEPTS, *supra* note 9, at 129.

110. Baker, *supra* note 101, at 574–77, 582.

111. BAUER, *supra* note 102, at 6, 92, 116.

112. Ruhl & Katz, *supra* note 45, at 209.

113. Rittel & Webber, *supra* note 1, at 165 (identifying the following attribute of wicked problems: “[e]very wicked problem can be considered to be a symptom of another problem.”).

114. Note that while some scholars use the term “new governance” as used here to capture the range of both state-centered and private action to reform governance in the wake of neoliberal reforms, *see, e.g.*, BEVIR, KEY CONCEPTS, *supra* note 9, at 4, others limit the term to primarily private action, *see, e.g.*, Burris et al., *supra* note 10, at 53. In collaboration with legal scholars, the AWG project views the role of law and government as prevalent even in the latter context in those states with strong democracy. Thus the AWG project and this Article use the broader conceptualization of “new governance.” *See also* Bradley C. Karkkainen, “New Governance” in *Legal Thought and in the World: Some Splitting as Antidote to Overzealous Lumping*, 89 MINN. L. REV. 471, 473 (2004) (noting these changes have been observed on both sides of the Atlantic).

115. Thomas Dietz, Elinor Ostrom & Paul C. Stern, *The Struggle to Govern the Commons*, 302 SCIENCE 1907, 1907–10 (2003).



*B. New Governance*

Many of the responses to the real and perceived failures of marketization and deregulation fall loosely into a category referred to as “new governance.” Descriptions of their emergence focus on the presence of two types of new governance approaches: networked governance and collaborative governance.

Networks describe the connections through which independent actors coordinate their activities.<sup>116</sup> In governance, highly diverse sets of networks emerge in response to gaps in existing governance and may appear as purely private or public, as well as public-private networks.<sup>117</sup> Networks appear among levels and sectors of government and may emerge among private organizations to fill the gap in state control as the globalized economy crosses state lines or local problems become too context specific for centralized bureaucracies to manage.<sup>118</sup>

Networks emerged initially as the result of the blending of markets and bureaucracy. The neoliberal reforms of the 1980s did not eliminate the prevalence of agencies but shifted aspects of their role to coordinating or steering a much more diffuse public and private form of governance.<sup>119</sup> This reassertion of state-centered control differs from the top-down command and control approach. Because private actors are not subject to the same limits on authority and process as a regulatory agency, the instruments governments use to “steer” networked governance are more indirect, including setting the goals or standards that must be achieved without dictating the manner of doing so.<sup>120</sup>

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116. BEVIR, KEY CONCEPTS, *supra* note 9, at 138.

117. Burris et al., *supra* note 10, at 13.

118. BEVIR, KEY CONCEPTS, *supra* note 9, at 140–41; Burris et al., *supra* note 10, at 16–17, 19–20; Peter Drahos & Martin Krygier, *Regulation, Institutions and Networks*, in REGULATORY THEORY: FOUNDATIONS AND APPLICATIONS 1, 15–16 (Peter Drahos ed., 2017). For the rise of private governance to fill the governmental gap in climate change mitigation, see VANDENBERGH & GILLIGAN, *supra* note 10, at 3–29; Michael P. Vandenbergh & Jonathan M. Gilligan, *Beyond Gridlock*, 40 COLUM. J. ENV'T L. 217, 243–60 (2015).

119. BEVIR, KEY CONCEPTS, *supra* note 9, at 139; BEVIR, THEORY GOV., *supra* note 9, at 162.

120. BEVIR, THEORY GOV., *supra* note 9, at 60–61. In Finland, salient examples of this approach include Green Deals that are nonlegally binding agreements between the Finnish government (Ministry of the Environment) and a branch of industry for advancing sustainable development goals. The Green Deals can be used for complementing and going beyond existing regulatory requirements on a voluntary basis. Currently, there are three such deals in Finland: (1) one for decreasing the use of plastic bags in the retail sector; (2) one for decreasing carbon emissions in the transportation sector; and (3) one for improving oil waste management. *Green Deals*, MINISTRY ENV'T, [https://www.ym.fi/en-US/Legislation/Green\\_Deals](https://www.ym.fi/en-US/Legislation/Green_Deals) (last updated Apr. 18, 2019, 10:14 AM) [<https://perma.cc/RB3E-LC3S>].

Networked governance may provide greater flexibility than top-down regulatory control and greater stability than markets.<sup>121</sup> Yet, this mix of private actors providing public services outside the reach of administrative law and the sheer complexity of public-private networks gives rise to concerns about accountability<sup>122</sup> and access.<sup>123</sup> The resulting lack of transparency may lead to unequal leverage over public decisionmaking,<sup>124</sup> with the corresponding need for government to intervene in order to assure access by those marginalized.<sup>125</sup> Collaborative governance is thought to address some of these issues by involving citizens in general, not merely those organized in powerful networks.

Collaborative governance reflects the emergent organization of citizens to address contextual problems not solved through centralized government action<sup>126</sup> and the efforts to increase citizen participation in government through processes that involve dialogue.<sup>127</sup> In contrast to networks, involvement in collaborative governance is not limited to private sector groups with sufficient capacity to organize and play an active role in decisionmaking or delivery of services but includes civil society in general.<sup>128</sup> The move to collaborative governance is driven both by complexity, and thus the need to bring multiple perspectives and local knowledge to bear on problems (increasing the chance that context-specific issues will be addressed and secondary impacts avoided), and by the need to respond to issues of legitimacy encountered in marketization and networked governance.<sup>129</sup> While some assert that collaborative governance increases transaction costs, others argue that the involvement of more actors up front speeds adoption of policies and avoids costly secondary consequences.<sup>130</sup>

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121. BEVIR, KEY CONCEPTS, *supra* note 9, at 140.

122. BEVIR, THEORY GOV., *supra* note 9, at 171; Burris et al., *supra* note 10, at 15.

123. Burris et al., *supra* note 10, at 28–29.

124. *Id.* at 14.

125. *Id.* at 33.

126. Chris Ansell & Alison Gash, *Collaborative Governance in Theory and Practice*, 18 J. PUB. ADMIN. RSCH. & THEORY 543, 543–71 (2008).

127. BEVIR, KEY CONCEPTS, *supra* note 9, at 47 n.5. In Finland, river-basin-specific Water Visions are good examples of collaborative governance. Water Vision is an emergent process in which a local government or municipal authority invites—without a direct government mandate—public and private stakeholders to build trust, discuss shared goals and take voluntary measures to improve water management, e.g., take measures to restore migratory fish populations. *See, e.g., Iijoen Vesistövisio*, AKORDI, <https://akordi.fi/portfolio-item/iijoen-vesistovisio/> (last visited Sept. 26, 2020) [<https://perma.cc/K8NN-R7NX>].

128. BEVIR, THEORY GOV., *supra* note 9, at 109.

129. BEVIR, KEY CONCEPTS, *supra* note 9, at 48.

130. *Id.* at 48–49.

The expanding role of private actors in government has led to a weakening of the role of the state and, at its worst, has “allow[ed] wealthier groups to seize the levers of governance available in diffuse systems of collective governance.”<sup>131</sup> This in turn alters the power of traditional state diplomacy to address problems of a global nature.<sup>132</sup> These consequences of new governance inform our approach to the role of government, which must consider how to retain the adaptive capacity and ability to contextualize exhibited by new governance while reasserting the role of government in assuring good governance. It should also be noted that not all the approaches to governance emerging to fill the gap as society undergoes rapid change are within the reach of existing law. Globalization of the economy as well as global pandemics place many activities beyond the reach of current instruments of state-centered governance. Organizations like Al Qaida are considered “dark networks” of governance.<sup>133</sup> Only a modification of the new governance responses of networks and collaboration within a larger governmental role have the potential to address the reach of these activities.

The legal scholars and political scientists whose work informs this article call for a more experimental<sup>134</sup> and contextualized<sup>135</sup> approach to governance. This exploration of the evolution of governance also reveals that legal and political science scholars characterize the current evolution in economic governance (i.e., “new governance”) as a response to increasing complexity. Many of the attributes are self-organizing and display emergent properties. Dorf and Sabel view this from the perspective of constitutional governance and call for “democratic experimentalism” that contemplates a role for government in facilitating innovation and recognizes that complexity requires an approach that allows for learning.<sup>136</sup> Bevir views this from the perspective of emerging new governance. His “decentered theory” recognizes that systems of governance also have emergent properties and the possibility of following multiple paths to alternative states. Decentered theory recognizes the complex legacy of history, culture, and geography in defining a governance pathway.<sup>137</sup> It captures the

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131. Burris et al., *supra* note 10, at 41.

132. *Id.* at 42.

133. *Id.* at 3–4.

134. Dorf & Sabel, *supra* note 81, at 288.

135. See BEVIR, *THEORY GOV.*, *supra* note 9, at 1 (“Governance is seen as a set of diverse practices that people are constantly creating and recreating through their concrete activity. Governance is explained by the narratives that the relevant actors first inherit as historical traditions and then revise in response to dilemmas.”).

136. Dorf & Sabel, *supra* note 81, at 267.

137. See BEVIR, *THEORY GOV.*, *supra* note 9, at 1 (“[D]ecentered theory emphasizes the diversity of governing practices and the importance of historical explanations of these practices.”).

2020]

*ENABLING ADAPTIVE GOVERNANCE*

1713

variance in system behavior not only at a point in time but through time by acknowledging the role of history.

Together, decentered theory and democratic experimentalism provide the framework for the role of government within governance. Viewing democratic experimentalism through the lens of decentered theory provides a bridge from the approach of Dorf and Sabel, primarily focused on the structure and function of government, to the empirical work on adaptive and new governance emerging to address complex problems. Furthermore, we believe it is no coincidence that new governance bears a striking resemblance to adaptive governance that has been observed and described by resilience scholars whose work is addressed in the following paragraphs. The parallels between new governance and adaptive governance allow us to draw from a more complete spectrum of disciplines to identify the appropriate role for government in the governance of complex problems.<sup>138</sup>

*C. Emerging Trends in Environmental Governance:  
Towards Adaptive Governance*

Environmental governance is the subset of governance that seeks to mediate human interaction with the environment.<sup>139</sup> This Section returns to ecological resilience theory and the corresponding recognition of its relevance for environmental management. The uptake of these concepts in social science led to empirical and theoretical work on the emergence of adaptive governance that occurred coincident with emergence of new governance and shares many of the same adaptations to complexity.

Following his mathematical development of resilience theory, C.S. (Buzz) Holling and colleagues developed additional concepts that are useful in application to social-ecological systems as heuristics to illustrate the path dependency of systems.<sup>140</sup> “Panarchy” captures the degree to which the capacity of a system to adapt or transform is influenced by or sensitive to changes at smaller and larger scales.<sup>141</sup> The “adaptive cycle” informs the trajectory of a system by recognizing that: (1) the capacity of a system to sustain growth declines as it matures; (2) fast and slow processes interact and may foster or erode adaptive

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138. Dorf & Sabel, *supra* note 81, at 288.

139. ROGERS & HALL, *supra* note 9, at 4; GOVERNANCE FOR THE ENVIRONMENT, *supra* note 9; UNITED NATIONS SYS. TASK TEAM, *supra* note 9, at 3–4.

140. C.S. Holling, Lance H. Gunderson & Donald Ludwig, *In Quest of a Theory of Adaptive Change*, in PANARCHY, *supra* note 35, at 5–14.

141. See C.S. Holling, Lance H. Gunderson & Garry D. Peterson, *Sustainability and Panarchies*, in PANARCHY, *supra* note 35, at 63.

capacity; and (3) interactions across scales may stabilize large-scale systems while providing opportunity for innovation and adaptation at small scales.<sup>142</sup> These concepts are illustrated by considering why a community dependent on a variable water supply that maximizes development during a period of wet years has limited room to adapt and thus faces scarcity during drought. The panarchy heuristic is also useful in understanding the pathways for governance intervention when a system approaches a threshold.<sup>143</sup> Thus, an agricultural system dependent on irrigation may collapse in the face of prolonged drought. Without external intervention, farmers may suffer or move to urban areas. In a nested system (i.e., panarchy), however, small-scale innovation as the threshold approaches, and knowledge and financial resources from higher levels, may allow the community to reorganize under new livelihoods or a new approach to farming.

In the mid-1970s, Holling and his colleagues were trying to apply systems concepts, tools, and models to managed natural resource systems, such as forestry systems, with managers attempting to control pest outbreaks in order to maintain a steady supply of wood for economic stability. They recognized that the nonlinear behavior and complexity led to deep uncertainties regarding the workings of nature and effects humans had on ecosystems. Human interventions that had environmental impacts could not be reliably predicted, or at an extreme, were inherently unpredictable. Hence, environmental management had to change from management by objective to seek social goals and stable outcomes, to management that was more flexible and adaptive to changing conditions. They called this new approach “adaptive management.”<sup>144</sup> Adaptive management is an experimental approach that involves learning by doing. “[U]nlike a traditional trial and error approach, adaptive management has explicit structure, including careful elucidation of goals, identification of alternative management objectives and hypotheses of causation, and procedures for the collection of data followed by evaluation and reiteration.”<sup>145</sup> While adaptive management has received considerable attention both in scholarship and agency work,<sup>146</sup> its application to landscape-scale systems has been

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142. See *id.*; C.S. Holling and Lance H. Gunderson, *Resilience and Adaptive Cycles*, in PANARCHY, *supra* note 35, at 25.

143. Chaffin & Gunderson, *supra* note 51, at 83–84.

144. ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (C.S. Holling ed., 1978); CARL J. WALTERS, ADAPTIVE MANAGEMENT OF RENEWABLE RESOURCES (1986).

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

146. BYRON K. WILLIAMS, ROBERT C. SZARO & CARL D. SHAPIRO, U.S. DEP'T OF THE INTERIOR, ADAPTIVE MANAGEMENT: THE U.S. DEPARTMENT OF THE INTERIOR TECHNICAL GUIDE (2009), <https://www.doi.gov/sites/doi.gov/files/migrated/ppa/upload/TechGuide.pdf> [https://perma.cc/

limited,<sup>147</sup> except in highly controlled situations.<sup>148</sup> In particular, in situations with multiple competing interests and multiple jurisdictions, a technocratic implementation of adaptive management fails because it lacks legitimacy.<sup>149</sup> This has led many authors to search for a governance framework within which adaptive management could be more effectively implemented.<sup>150</sup>

Thus, the simplest definition of “adaptive governance” is the governance needed to implement adaptive management. However, empirical work aimed at identifying types of governance with high adaptive capacity quickly moved beyond adaptive governance as simply the means to implement adaptive management to what is necessary to manage resilience (i.e., the behavior of complex systems).<sup>151</sup> This

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63XT-8DZW]; Niko Soininen & Froukje Maria Platjouw, *Resilience and Adaptive Capacity of Aquatic Environmental Law in the EU, in THE ECOSYSTEM APPROACH IN OCEAN PLANNING AND GOVERNANCE* 17 (David Langlet & Rosemary Rayfuse eds., 2019).

147. John M. Volkman & Willis E. McConaha, *Through a Glass, Darkly: Columbia River Salmon, the Endangered Species Act, and Adaptive Management*, 23 ENV'T L. 1249, 1258–63 (1993) (applying adaptive management analysis in the salmon conservation context); Kai N. Lee, *Appraising Adaptive Management*, 3 CONSERVATION ECOLOGY, no. 2, Sept. 8, 1999, at 1, <https://www.ecologyandsociety.org/vol3/iss2/art3/> [<https://perma.cc/2ABN-DCJP>] (general discussion of challenges of following an adaptive management approach for “natural resource management and biodiversity conservation”); Gunderson & Light, *supra* note 40, at 323–24 (applying adaptive management to Everglades conservation efforts); Gunderson et al., *Escaping a Rigidity Trap*, *supra* note 74, at 149–54 (discussing adaptive governance in the context of management in the Everglades); Gunderson et al., *Social, Legal, and Ecological Capacity*, *supra* note 74; Nikolaos Voulvoulis, Karl Dominic Arpon & Theodoros Giakoumis, *The EU Water Framework Directive: From Great Expectations to Problems with Implementation*, 575 SCI. TOTAL ENV'T, 358, 358–66 (2017).

148. Karl W. Flessa, Edward P. Glenn, Osel Hinojosa-Huerta, Carlos A. de la Parra-Rentería, Jorge Ramírez-Hernández, John C. Schmidt & Francisco A. Zamora-Arroyo, *Flooding the Colorado River Delta: A Landscape-Scale Experiment*, 94 EOS, TRANSACTIONS, AM. GEOPHYSICAL UNION 485, 485–86 (2013); *see also* Robin Kundis Craig & J.B. Ruhl, *Designing Administrative Law for Adaptive Management*, 67 VAND. L. REV. 1, 45 (2014) (presenting a draft administrative law for adaptive management and noting that it is only appropriate under controlled conditions).

149. Barbara Cosens, *Transboundary River Governance in the Face of Uncertainty: Resilience Theory and the Columbia River Treaty*, 30 U. UTAH J. LAND RES. & ENV'T L. 229, 229–65 (2010) [hereinafter Cosens, *Transboundary*]; Barbara A. Cosens, *Legitimacy, Adaptation, and Resilience in Ecosystem Management*, 18 ECOLOGY & SOC'Y, no. 1, 2013, at 1–2 [hereinafter Cosens, *Legitimacy*], <http://dx.doi.org/10.5751/ES-05093-180103> [<https://perma.cc/D23V-BQ45>] (PDF download available at URL provided); Lee, *supra* note 147.

150. *See* Dietz et al., *supra* note 115, at 1908–10 (developing the concept of adaptive governance in complex systems and proposing certain strategies for meeting these requirements); Carl Folke, Thomas Hahn, Per Olsson & Jon Norberg, *Adaptive Governance of Social-Ecological Systems*, 30 ANN. REV. ENV'T & RES. 441, 452 (2005) (setting the foundation for much of the literature on adaptive governance after Dietz et al. coined the term).

151. Folke et al., *supra* note 150, at 457; Louis Lebel, John M. Anderies, Bruce Campbell, Carl Folke, Steve Hatfield-Dodds, Terry P. Hughes & James Wilson, *Governance and the Capacity to Manage Resilience in Regional Social-Ecological Systems*, 11 ECOLOGY & SOC'Y, no. 1, 2006, at 2, 8, <http://www.ecologyandsociety.org/vol11/iss1/art19/> [<https://perma.cc/D64G-R3WG>] (PDF download available at URL provided); Dave Huitema, Erik Mostert, Wouter Egas, Sabine Moellenkamp, Claudia Pahl-Wostl & Resul Yalcin, *Adaptive Water Governance: Assessing the Institutional Prescriptions of Adaptive (Co-)Management from a Governance Perspective and*

broader focus is consistent with the recognition that adaptive management requires the ability to control experiments.<sup>152</sup> In contrast, most large landscapes are “characterized by competing interests, jurisdictional complexity, and multiple drivers of change, and thus the ability to identify single management goals and to control experimentation is limited.”<sup>153</sup> In addition, power structures within and controlling decisionmaking are not explained by resilience theory. In fact, agency, power, and empathy may not only change the feedbacks in social systems in ways that are not analogous to the response of ecosystems but may be the driving force behind the response of social systems to change.<sup>154</sup> Thus, while it may be one tool to address certain aspects of wicked problems, adaptive management alone is insufficient. Importantly, empirical work by social scientists who embraced resilience theory has begun to describe a new form of governance emerging in complex settings, including those in which governmental gaps existed.<sup>155</sup>

Elinor Ostrom and her lab documented self-organization of resource-dependent communities from fishing villages to irrigation districts, finding that even in the absence of regulation, communities are capable of self-organizing to assure sustainability of the resource.<sup>156</sup> Importantly, Ostrom’s work refuted Garret Hardin’s position in his famous essay, *The Tragedy of the Commons*,<sup>157</sup> that only private ownership or government regulation could prevent the overuse of common pool resources.<sup>158</sup> After the initial publication in 1990, Ostrom’s lab continued to study the phenomenon of social self-organization and to develop a framework for the conditions under which it is likely to emerge.<sup>159</sup> She collaborated with Dietz et al. in coining the

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*Defining a Research Agenda*, 14 *ECOLOGY & SOC’Y*, no. 1, 2009, <https://www.ecologyandsociety.org/vol14/iss1/art26/> [<https://perma.cc/RC56-VF7X>] (PDF download available at URL provided); Cosens & Gunderson, *supra* note 9, at 3–4; Cosens et al., *supra* note 10, at 4.

152. Craig & Ruhl, *supra* note 148, at 18, 34.

153. Cosens et al., *supra* note 10, at 4.

154. Debra J. Davidson, *The Applicability of the Concept of Resilience to Social Systems: Some Sources of Optimism and Nagging Doubts*, 23 *SOC’Y & NAT. RES.* 1135, 1143–45 (2010); see Craig, *supra* note 26, at Part II (noting that resilience theory does not capture aspects of “social capriciousness” present in wicked problems).

155. OSTROM, *supra* note 49, at 15–18.

156. *Id.* at 58–102.

157. Garrett Hardin, *The Tragedy of the Commons*, 162 *SCIENCE* 1243 (1968).

158. Locher, *supra* note 49, at 534. In 2009, Elinor Ostrom was awarded the Nobel Prize in Economics for this work.

159. Elinor Ostrom, *A General Framework for Analyzing Sustainability of Social-Ecological Systems*, 325 *SCIENCE* 419, 419–22 (2009) (creating a framework to identify variables that affect self-organization).

2020]

## ENABLING ADAPTIVE GOVERNANCE

1717

term “adaptive governance” and identifying the conditions under which robust locally based adaptive governance is possible.<sup>160</sup>

This work was furthered when the Resilience Alliance (“RA”) formed in 1999, as “an international, multidisciplinary research organization that explores the dynamics of social-ecological systems. RA members collaborate across disciplines to advance the understanding and practical application of resilience, adaptive capacity, and transformation of societies and ecosystems in order to cope with change and support human well-being.”<sup>161</sup> This productive collaboration brought social scientists like Carl Folke and Elinor Ostrom together with the architects of ecological resilience theory, and work began on bridging the empirical observation of adaptive governance with resilience theory.<sup>162</sup>

Inspiring the approach in this article, Folke et al. “explore the social dimension that enables adaptive ecosystem-based management”<sup>163</sup> while maintaining the nonnormative focus of ecological resilience theory and turn to social science for insights on how to manage (rather than achieve) resilience.<sup>164</sup> The work of the authors is empirically based and recognizes that not only do social systems exhibit behavior of complex adaptive systems<sup>165</sup> but that social-ecological systems are intertwined in ways that include feedback across systems and result in emergent properties not explained through the study of each in isolation.<sup>166</sup> They describe collaborative networks and bridging organizations across polycentric governmental and nongovernmental entities that provide a setting in which learning can take place at both the local and policy-setting levels and adaptive management can find social acceptance.<sup>167</sup> With devolution of

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160. Dietz et al., *supra* note 115, at 1907 n.28.

161. *About*, RESILIENCE ALL., <https://www.resalliance.org/about> (last visited Sept. 26, 2020) [<https://perma.cc/3SAZ-QEFE>]. For an interesting study analyzing why the Resilience Alliance has been such a successful collaboration, see John N. Parker & Ugo Corte, *Placing Collaborative Circles in Strategic Action Fields: Explaining Differences Between Highly Creative Groups*, 35 SOCIO. THEORY 261, 276–79 (2017), for a discussion of how the use of nontraditional venues, among other factors, by the Resilience Alliance contributed to its success, see John N. Parker & Edward J. Hackett, *Hot Spots and Hot Moments in Scientific Collaborations and Social Movements*, 77 AM. SOCIO. REV. 21 (2012), for a discussion of how emotion and moments of intense collaborative action shaped the Resilience Alliance.

162. Folke et al., *supra* note 150, at 443–47, 452–53.

163. *Id.* at 442.

164. *Id.* at 441, 443.

165. *Id.* at 443.

166. *Id.* (citing NAVIGATING SOCIAL-ECOLOGICAL SYSTEMS: BUILDING RESILIENCE FOR COMPLEXITY AND CHANGE (Fikret Berkes, Johan Colding & Carl Folke eds., 2003)).

167. *Id.* at 444, 447–54.



management to the scale of the problem, feedback from management actions can be detected.<sup>168</sup>

In the context of water governance, Huitema et al.<sup>169</sup> seek to bridge the literature on “adaptive (co)management” (a term proponents of adaptive management began using when it was clear that landscape- or basin-scale implementation required a more collaborative and political process than the technocratic implementation of science-based experimentation) and the emerging literature on governance and adaptive governance, focusing in particular on the literature on institutions (e.g., the Ostrom school of thought).<sup>170</sup> In doing so, they find common ground among various disciplinary articles on adaptive comanagement and governance first from the scholarship alone and then by looking for evidence in water governance.<sup>171</sup> They identify many of the same attributes, noting that public participation also increases innovation, transparency, and democracy.<sup>172</sup> Their observation identifies one of the defining factors of the scale of adaptive governance by noting that in water systems adaptive governance emerges at the bioregional (i.e., problem) scale.<sup>173</sup>

Chaffin et al. provided a review of environmental adaptive governance literature in 2014.<sup>174</sup> Their work is an outgrowth of the efforts of the RA to engage in dialogue with people in the policy sciences and law,<sup>175</sup> but they also review literature from scholars of emerging trends in community-based management who applied the term

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168. *Id.* at 451.

169. Huitema et al., *supra* note 151, at 1.

170. *Id.* at 1–2.

171. *Id.*

172. *Id.* at 5–7.

173. *Id.* at 9–11.

174. Chaffin et al., *supra* note 56, at 1–2.

175. The first law and resilience conference, *Law for Social-Ecological Resilience International and Transdisciplinary Conference*, STOCKHOLM UNIV., <http://www.juridicum.su.se/resilience/> (last visited Sept. 26, 2020) [<https://perma.cc/72JV-DRDH>] [hereinafter *Law and Resilience Conference*], at the University of Stockholm resulted in: a two-part special issue of *Ecology and Society*, LAW AND SOCIAL-ECOLOGICAL RESILIENCE, PART I: CONTRIBUTIONS FROM RESILIENCE 2011, in 18 *ECOLOGY AND SOC'Y (SPECIAL ISSUE)* (2013), <https://www.ecologyandsociety.org/issues/view.php?sf=78> [<https://perma.cc/R2PY-VXKF>] [hereinafter SPECIAL ISSUE PART I] (PDF download available at URL provided); LAW AND SOCIAL-ECOLOGICAL RESILIENCE, PART II: CONTRIBUTIONS FROM LAW FOR SOCIAL-ECOLOGICAL RESILIENCE SYMPOSIUM, in 18 *ECOLOGY AND SOC'Y (SPECIAL ISSUE)* (2013), <https://www.ecologyandsociety.org/issues/view.php/feature/98> [<https://perma.cc/JHU3-PNKK>] [hereinafter SPECIAL ISSUE PART II] (PDF download available at URL provided); a panel bringing together ecologists and legal scholars at the Resilience 2011 conference, *Resilience 2011 – Resilience, Innovation and Sustainability: Navigating the Complexities of Global Change*, ARIZ. STATE UNIV., <https://sustainability.asu.edu/events/rsvp/resilience-2011/> (last visited Sept. 26, 2020) [<https://perma.cc/X25M-DJTA>] [hereinafter *Resilience Conference*], at Arizona State University; and the book *SOCIAL-ECOLOGICAL RESILIENCE AND LAW* (Ahjond S. Garmestani & Craig R. Allen eds., 2014).

2020]

*ENABLING ADAPTIVE GOVERNANCE*

1719

adaptive governance to cases where managing uncertainty had become critical.<sup>176</sup> They identify emergent processes that arise through networks across multiple sectors and jurisdictions to achieve dialogue and action at the scale of the problem.<sup>177</sup>

As with the scholars of new governance, adaptive governance scholars had begun to identify problems of good governance associated with private collective action. This focus on the emergent, or bottom-up, aspects of adaptive governance would require additional disciplinary input from the policy disciplines to understand the larger governance frameworks in which these processes might emerge.

Lebel et al. further the exercise of bridging resilience to the social and political sciences not only by analyzing the type of governance needed to manage resilience but by considering what is necessary for society to accept a more flexible form of governance. By bringing in other disciplinary perspectives, they emphasize that “we not only need to ask: The resilience of what, to what? We must also ask: For whom?”<sup>178</sup> They draw from the literature on adaptive governance to inform how to manage resilience, and from the literature on “good governance”<sup>179</sup> that considers aspects of legitimacy<sup>180</sup> and as a result, come closer to bridging this literature to governance scholarship in the legal and political sciences.

In addition to describing similar attributes of adaptive governance, Lebel et al. use case studies to illustrate the integration of good governance and the capacity to manage resilience. They find some evidence that participation and deliberation build the necessary trust and networks to facilitate self-organization and that deliberation facilitates the learning necessary to adapt to change.<sup>181</sup> In addition, they find some evidence that polycentric, multilayered governance not only improves the fit of governance to the scale of the problem but facilitates the use of local knowledge, increasing the chance of early warning of the impacts of change, and that accountability and checks on power may enhance the capacity of marginalized groups to adapt, ensuring an equitable distribution of benefits.<sup>182</sup>

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176. Chaffin et al., *supra* note 56, at 6–8.

177. *Id.* at 7.

178. Lebel et al., *supra* note 151, at 1. The authors recognize that the writers of that article use the normative definition of resilience. To avoid that, we would substitute the term “adaptive capacity.”

179. *Id.* at 4.

180. *Id.*; see also Cosens, *Legitimacy*, *supra* note 149, at 5–8.

181. Lebel et al., *supra* note 151, at 5–8.

182. *Id.* at 8–11.

Contemporaneously with the development of a shared understanding of adaptive governance, scholars of environmental governance began to bridge their work with the broader scholarship on governance. This led to recognition of common attributes between new governance and adaptive governance.<sup>183</sup> These scholars discuss the rise of new governance as a result of increasing interdependency and interaction as well as the desire for a greater citizen voice in natural resources management.<sup>184</sup> The work of Lockwood et al. stands out in this interdisciplinary effort.

Although they do not use the term “adaptive governance,” Lockwood et al. draw on the new governance literature as well as the literature on development, sustainability, and adaptive governance to develop eight principles for natural resource management and governance. Similar to the work of Lebel et al., this interdisciplinary approach results in principles that reflect an understanding of both society and ecosystems and the need for governance capable of addressing problems “characterized by complexity, uncertainty, interdependency, and deficiencies in resources, expertise, and knowledge.”<sup>185</sup> Their eight principles include aspects of good governance and adaptive capacity. They are: (1) legitimacy; (2) transparency; (3) accountability; (4) inclusiveness; (5) fairness; (6) integration; (7) capability; and (8) adaptability.<sup>186</sup>

The literature on adaptive governance developed by scholars in more and more disciplines began describing similar phenomena, identifying those components relevant within their disciplines. Consistent with theories of new governance, the result is not a list of criteria that make up adaptive governance but an ever-broadening picture of the various processes of governance that increase the capacity of society to manage change and uncertainty in complex systems. Also consistent with new governance theory, these processes are bottom-up and emerge through networks and collaboration that arise at the scale of the particular problem and by their nature are contextualized not only to account for the nuances of the problem in that particular space but to account for the variance in history and culture of the society

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183. See, e.g., Lee, *supra* note 79, at 14 (arguing for use of IAD from the work of Nobel Laureate Elinor Ostrom framework to analyze new governance); Karkkainen, *supra* note 114, at 494–95 (proposing use of adaptive management principles in new governance scholarship); Michael Lockwood, Julie Davidson, Allan Curtis, Elaine Stratford & Rod Griffith, *Governance Principles for Natural Resource Management*, 23 SOC’Y & NAT. RES. 986, 986 (2010) (examining ability of new governance to handle uncertainties).

184. Lockwood et al., *supra* note 183, at 988.

185. *Id.* at 990.

186. *Id.* at 991–97.

affected.<sup>187</sup> However, despite the recognition of the social context, including the need for legitimacy by Lebel et al. and Lockwood et al., a major gap remained in whether and how government (and therefore law) plays a role in adaptive governance. We turn in Part III to the ongoing efforts of legal scholars of adaptive governance to close that gap.

### III. ADAPTIVE LAW: ENABLING GOVERNANCE FOR COMPLEX SOCIAL-ECOLOGICAL SYSTEMS

Legal scholars brought to the table the importance of government and law in removing barriers to and opening windows of opportunity for adaptive governance, facilitating and participating in adaptive governance, and assuring its legitimacy.<sup>188</sup> The authors participated in these efforts by undertaking a systematic study of the role of law in adaptive governance in the United States and a follow-up process to these concepts to the EU in general and Finland in particular.<sup>189</sup> These projects build on previous work to identify aspects of adaptive governance that are emergent under the right conditions and the aspects that must be intentional in the structure, capacity, and process of government defined by law if adaptive governance is to emerge, succeed, have legitimacy, and keep pace with accelerating change.

Informing the role of formal law and government in managing wicked problems is an interdisciplinary exercise and requires the integration of aspects of the governance literature, including new

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187. Folke et al., *supra* note 150, at 447–50.

188. Cosens, *Transboundary*, *supra* note 149, at 238–41. See SPECIAL ISSUE PART I, *supra* note 175; SPECIAL ISSUE PART II, *supra* note 175; SOCIAL-ECOLOGICAL RESILIENCE AND LAW, *supra* note 175, at 1–14.

189. For background, see the authors' note. See also Barbara A. Cosens, Robin K. Craig, Shana Lee Hirsch, Craig Anthony (Tony) Arnold, Melinda H. Benson, Daniel A. DeCaro, Ahjond S. Garmestani, Hannah Gosnell, J.B. Ruhl & Edella Schlager, *The Role of Law in Adaptive Governance*, 22 *ECOLOGY AND SOC'Y*, no. 1, 2017, <https://www.ecologyandsociety.org/vol22/iss1/art30/> [<https://perma.cc/K36T-HPQX>] [hereinafter Cosens et al., *Role of Law*] (PDF download available at URL provided); Barbara A. Cosens, Robin Kundis Craig, Shana Hirsch, Craig Anthony Arold, Melinda Harm Benson, Daniel DeCaro, Ahjond S. Garmestani, Hannah Gosnell, J.B. Ruhl & Edella Schlager, *Legal Pathways to Adaptive Governance in Water Basins in North America and Australia*, in *PRACTICAL PANARCHY*, *supra* note 9, at 151–66 [hereinafter Cosens et al., *Legal Pathways*] (discussing the evolution of law to facilitate adaptive governance in basin studies); Barbara Cosens, Lance Gunderson, & Brian Chaffin, *Introduction: The Adaptive Water Governance Project: Assessing Law, Resilience and Governance in Regional Socio-ecological Water Systems Facing a Changing Climate*, 51 *IDAHO L. REV.* 1 (2014) [hereinafter Cosens et al., *Introduction to AWG Project*] (examining role of law in adaptive governance of water systems); Ruhl & Salzman (2020), *supra* note 94. For the EU-Finnish part, the project is still underway while writing this article, see *Frontpage*, BLUEADAPT, <https://blueadapt.fi/en/frontpage/> (last visited Sept. 26, 2020) [<https://perma.cc/Q6LW-8TGU>], for updates on and descriptions of the EU project.

governance and democratic experimentalism, as well as an understanding of the behavior of complex systems. To this end, Part I established how complex systems function and concluded with seven common features of complex systems in the literature on systems thinking, complexity theory, and ecological resilience that may be relevant to governance in a time of accelerating change: (1) self-organization; (2) emergence; (3) networks; (4) feedback; (5) nonlinearity; (6) cross scale interactions; and (7) uncertainty. Part II elaborated how these features had influenced the development of new governance theories in general and adaptive governance theory in particular. The following Section seeks to: (1) situate formal law and government in adaptive governance literature; and (2) consider key criteria for a legal framework facilitating adaptive governance.

#### *A. Situating Law Within the Adaptive Governance Literature*

Returning to the work of Elinor Ostrom, Locher (an environmental historian) finds it no coincidence that Ostrom's work on community self-organization and its influence in both policing in the United States and development work globally arose at a time of increasing frustration with large, top-down government.<sup>190</sup> Because the Ostrom line of scholarship leading to identification of adaptive governance was based on empirical work, it supports the notion that the rise in private and public-private networks may be catalyzed by the need to fill a governance (i.e., governmental) gap. It is also important to note that while much of Ostrom's work focuses on the self-governing nature of local adaptive governance, the criteria for its robust development articulated in Dietz et al. is almost entirely composed of actions that may be facilitated by law and that require actions and networks at governmental levels above the local. The criteria from Dietz et al. include: congruence of rules with ecological conditions; clear boundaries and defined rights; enforced sanctions; mechanisms for dispute resolution; institutional variety; accountability; analytical deliberation/participation; and nesting.<sup>191</sup> The rise of private governance as a form of self-organization to fill gaps in environmental governance<sup>192</sup> requires, at a minimum, attention to government to

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190. Locher, *supra* note 49, at 557.

191. Dietz et al., *supra* note 115, at fig.3.

192. See VANDENBERGH & GILLIGAN, *supra* note 10, at 3–5, 8–12 (arguing a concerted effort by private actors to effort to reduce emissions can be used to gain compliance with the Paris climate change agreement in the interim while governmental bodies overcome gridlock); Vandenberg & Gilligan, *supra* note 118 (discussing private governance actions to address rising carbon emissions in presence of governmental gridlock).

2020]

*ENABLING ADAPTIVE GOVERNANCE*

1723

remove barriers, prevent capture by more powerful interests, and facilitate more rapid response.

Thus, the importance of government is implicitly acknowledged but not the focus of the approach of institutionalists. In contrast, democratic experimentalism based on legal scholarship focuses almost entirely on the role of government within a constitutional framework to navigate increasing complexity and uncertainty, only touching on the emergent role of self-organization and private governance it seeks to foster.<sup>193</sup>

Governance, new governance, and decentered theory from political science look at both sides of the governance puzzle—that is, what is happening in society and how government is evolving in response. Thus, scholars like Mark Bevir provide us with a lens to bridge the empirically based scholarship on the bottom-up emergence of self-organized networks, private governance, and collaborative governance, and the legal scholarship focused on the governmental response. Both aspects are necessary to achieve timely adaptive governance.<sup>194</sup>

The early work on adaptive governance revealed that self-organization, emergence that is context specific, and networks are all present, and in fact, defining attributes of adaptive governance. What scholars did not ask was: What must the legal/governmental component of adaptive governance look like to speed up its emergence and allow it to succeed? Recognizing the gap between adaptive governance literature and legal scholarship, the Stockholm Resilience Centre and Faculty of Law at Stockholm University brought legal and resilience scholars together in 2010.<sup>195</sup> Conversations in Stockholm led the RA to dedicate one session at their 2011 gathering to law and resilience.<sup>196</sup> These combined gatherings resulted in two collections of publications identifying the role law plays in erecting barriers to adaptive governance and management due to its focus on maintaining social stability and setting the stage for further work to consider law as a means to manage change while protecting the social need for stability.<sup>197</sup>

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193. See Dorf & Sabel, *supra* note 81, at 311–23.

194. Cosens et al., *Role of Law*, *supra* note 189; Cosens et al., *Legal Pathways*, *supra* note 189, at 160–61.

195. *Law and Resilience Conference*, *supra* note 175. Having just published one of the early articles on law and adaptive governance, Cosens, *Transboundary*, *supra* note 149, lead author Cosens was privileged to be a plenary speaker at this gathering.

196. *Resilience Conference*, *supra* note 175.

197. See SPECIAL ISSUE PART I, *supra* note 175; SPECIAL ISSUE PART II, *supra* note 175.

Building on that work, the Adaptive Water Governance (“AWG”) Project<sup>198</sup> relied on both theory and empiricism. It used case studies of social-ecological management of North American water basins—a wicked problem if ever there was one—to create a cross-disciplinary dialogue among ecologists and legal scholars<sup>199</sup> searching for any empirical support for the hypothesis that adaptive governance is emerging in heavily managed systems and that government and law play a role.<sup>200</sup> The project specifically asked: Does law present barriers to adaptive governance? May law play a role in triggering, facilitating, and institutionalizing adaptive governance? And if so, what is the role of formal legal institutions in adaptive governance?<sup>201</sup> The answers are: yes; yes; and, in keeping with decentered theory, it depends on the context.

Law presents barriers to adaptive governance by favoring stability over flexibility<sup>202</sup> and by providing for judicial review in advance of experimentation.<sup>203</sup> It may also inhibit innovation in private governance through the application of one-size-fits-all solutions. Yet complexity and resilience theories caution that the rigid maintenance of stability in the face of unprecedented rates of change could itself be destabilizing. Furthermore, the framing of wicked problems cautions that high-level planning and implementation lacks the contextualization needed to address issues such as climate change mitigation or adaptation to its impacts on the environment. Nesting of

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198. For background, see the authors’ footnote.

199. See Cosens et al., *Introduction to AWG Project*, *supra* note 189.

200. Craig Anthony (Tony) Arnold, Hannah Gosnell, Melinda H. Benson & Robin K. Craig, *Cross-Interdisciplinary Insights into Adaptive Governance and Resilience*, 22 *ECOLOGY & SOC’Y*, no. 4, 2017, at 1, <https://www.ecologyandsociety.org/vol22/iss4/art14/> [<https://perma.cc/Q7GL-GXWN>] (PDF download available at URL provided); Craig Anthony (Tony) Arnold, Hannah Gosnell, Melinda Harm Benson & Robin Kundis Craig, *Cross-Basin Patterns of Systemic-Change Drivers and Adaptive Governance Features*, in *PRACTICAL PANARCHY*, *supra* note 9, at 205, 205–28; Cosens et al., *Role of Law*, *supra* note 189; Cosens et al., *Legal Pathways*, *supra* note 189, at 153; Craig et al., *Balancing Stability and Flexibility*, *supra* note 73; Craig et al., *Stability and Flexibility*, *supra* note 73, at 168–69; Daniel A. DeCaro, Brian C. Chaffin, Edella Schlager, Ahjond S. Garmestani & J.B. Ruhl, *Theory and Research to Study the Legal and Institutional Foundations of Adaptive Governance*, in *PRACTICAL PANARCHY*, *supra* note 9, at 269, 269–88 [hereinafter DeCaro et al., *Theory and Research*]; Daniel A. DeCaro, Brian C. Chaffin, Edella Schlager, Ahjond S. Garmestani & J.B. Ruhl, *Legal and Institutional Foundations of Adaptive Environmental Governance*, 22 *ECOLOGY & SOC’Y*, no. 1, 2017, at 1 [hereinafter DeCaro et al., *Legal and Institutional Foundations*], <https://www.ecologyandsociety.org/vol22/iss1/art32/> [<https://perma.cc/WPT8-85VS>] (PDF download available at URL provided).

201. See Cosens et al., *Role of Law*, *supra* note 189.

202. Craig et al., *Balancing Stability and Flexibility*, *supra* note 73; Craig et al., *Stability and Flexibility*, *supra* note 73, at 169.

203. Gunderson et al., *Escaping a Rigidity Trap*, *supra* note 74, at 153, 155; Gunderson et al., *Social, Legal, and Ecological Capacity*, *supra* note 74, at 72–76, 78; Dorf & Sabel, *supra* note 81, at 463–64.

governance capable of local innovation within higher levels of government that set goals can provide flexibility within a stable framework.<sup>204</sup> Facilitation of private governance across international boundaries can accelerate response to global issues. Dorf and Sabel's work informs the AWG Project by considering how to foster democratic experimentalism within a constitutional framework. They provide an approach to break the gridlock of judicial review, suggesting review focused on whether the posed implementation measure has a reasonable relation to the goal; whether implementation is achieving outcomes that are trending toward the specified goal; and whether there is any violation of individual rights.<sup>205</sup> In addition, they would replace process-based review with substantive judicial review to address instances of alleged corruption associated with lack of inclusion in collaborative governance<sup>206</sup> and oversight to reduce the potential for corruption in private governance.

In keeping with the governance scholarship that recognizes the emergence of networks, private governance, and collaboration as a response to complexity and the failure of government to manage it effectively, adaptive governance appears to emerge in response to a social or biophysical disturbance. Thus, the greater extremes of flood and drought occurring as society goes down the path of climate change are resulting in the emergence of processes networked across sectors and levels and among public and private actors to allow response at the scale of the problem.<sup>207</sup> But law also creates disturbance. In several of the basins studied by the AWG project, the application of regulatory law to complex systems (e.g., environmental law) created such unwieldy results that adaptive governance emerged in the search for better solutions.<sup>208</sup> The studies also demonstrated frequent failure in

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204. Craig et al., *Balancing Stability and Flexibility*, *supra* note 73; Cosens et al., *Legal Pathways*, *supra* note 189, at 157–58; Cosens et al., *Role of Law*, *supra* note 189; Cosens et al., *Introduction*, *supra* note 189, at 11.

205. Dorf & Sabel, *supra* note 81, at 288, 398–400.

206. *See id.* at 399–400 (explaining that judicial review would examine the size of the gap between actors' actions and their stated purposes to determine whether they are truly pursuing their goals).

207. *See* Barbara Cosens, *Water Law Reform in the Face of Climate Change: Learning from Drought in Australia and the Western United States*, 33 ENV'T & PLAN. L.J. 372, 386–87 (2016) (discussing the need for increased adaptability in regulation in light of a rising likelihood of extreme flooding or drought).

208. *See* Brian C. Chaffin, Robin Kundis Craig & Hannah Gosnell, *Resilience, Adaptation, and Transformation in the Klamath River Basin Social-Ecological System*, 51 IDAHO L. REV. 157, 162–63 (2014) [hereinafter Chaffin et al., *Resilience*] (stating that federal, state, and local law and institutions has worsened the environmental impact in the Klamath River Basin); Brian C. Chaffin, Hannah Gosnell & Robin K. Craig, *The Emergence of Adaptive Governance in the Klamath River Basin*, in PRACTICAL PANARCHY, *supra* note 9, at 83, 84–86 [hereinafter Chaffin et al.,



governmental facilitation of adaptive governance and institutionalization of results, leading to the conclusion that legal authority is needed in these areas.<sup>209</sup>

The role of formal institutions in adaptive governance encompasses many of the activities contemplated by Dorf and Sabel for democratic experimentalism, which in turn provides the constitutional justification for authorizing facilitation of adaptive governance. Thus, at higher levels of government, agencies provide resources,<sup>210</sup> pool knowledge, and coordinate across actors seeking to innovate in the face of similar problems. Drawing from the adaptive governance scholarship, levels of government within or at the scale of the problem participate through cross-sector, cross-level, and public-private networks focused on innovation within the local to global context. Drawing from both the adaptive governance and broader governance literature, the increasing role for private actors through networks or collaboration raises concerns with legitimacy (including accountability and transparency), equity, and justice. Once again, both participating and higher levels of government have a role to play in assuring legitimacy and access as well as in building local capacity within marginalized groups to participate. The judiciary must provide checks on injustice and inequity in access as well as in uneven distribution of benefits, but timing must be carefully tailored to avoid gridlock.

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*Klamath River Basin*] (describing the frustration of stakeholders with conflicting federal statutes and mandates on resource distribution and conservation of water basins).

209. See Cosens et al., *Role of Law*, *supra* note 189 (providing a framework for legal reform); Cosens et al., *Legal Pathways*, *supra* note 189, at 158–59 (“[I]n the context of adaptive capacity, there is currently a lack of legal mechanisms at any level that allow for alternatives to traditional environmental enforcement—alternatives that could enhance local innovation while maintaining stability and accountability toward achieving the goals that traditional enforcement mechanisms seek to achieve.”); DeCaro et al., *Theory and Research*, *supra* note 200, at 278 (“In addition to reluctance to devolve responsibility and inadequate legal authority to self-organize . . . insufficient administrative and technical support are major sources of adaptive and cooperative failures in environmental governance.”); DeCaro et al., *Legal and Institutional Foundations*, *supra* note 200, at 1 (“One of the biggest challenges for . . . adaptive governance is to develop formal legal frameworks—legal principles, laws, and regulatory mechanisms—that support such adaptation without stifling stakeholders’ inherent self-organizing potential or the emergent properties of adaptation itself.”).

210. While beyond the scope of this article, the work of economist Mariana Mazzucato recognizing the critical role of government in stimulating innovation for the good of society and a sustainable economy is important on the issue of the role of government. See MARIANA MAZZUCATO, *THE VALUE OF EVERYTHING: MAKING AND TAKING IN THE GLOBAL ECONOMY* (2018) [hereinafter MAZZUCATO, *VALUE*]; RETHINKING CAPITALISM: ECONOMICS AND POLICY FOR SUSTAINABLE AND INCLUSIVE GROWTH (Michael Jacobs & Mariana Mazzucato eds., 2016); MARIANA MAZZUCATO, *THE ENTREPRENEURIAL STATE* (rev. ed. 2015) [hereinafter MAZZUCATO, *ENTREPRENEURIAL*].

2020]

*ENABLING ADAPTIVE GOVERNANCE*

1727

*B. Unpacking the Role of Formal Law and Government in Adaptive Governance*

Adaptive governance is an emergent, self-organizing phenomenon, but it is clear that government participates, facilitates, and, at times, gets in the way of its success. The new insights from multiple disciplines and understanding of the emergent attributes of adaptive governance that adaptive law must foster set the stage for unpacking the legal/governmental (or intentional) role in adaptive governance and identifying how and when it can speed the process. The role of formal law and government plays out in four categories.

*Government structure.* Building on the work of Dorf and Sabel, this category focuses on the level and type of authority assigned to agencies and the use of federal/state relations as contemplated by cooperative federalism in the United States or subsidiarity in the EU to balance stability and flexibility and to assure the authority to network across governmental sectors, levels, and with private entities working within an established constitutional framework. To balance stability and flexibility, the authority to innovate and adaptively manage must be delegated to the level of government closest to the problem while nesting that innovation in a higher level of government with clear, legally binding goals and standards.<sup>211</sup> Administrative law and the substantive authority for agencies at all levels of government to network across sectors and with private entities to provide integrated coordination and response<sup>212</sup> must place boundaries on the processes to assure accountability and inclusion.

*Government's role in capacity building.* The benefits of distributed innovation still leave considerable room for a governmental role in catalyzing change and ensuring inclusion in the process of change. Climate change mitigation and adaptation are among the most wicked problems facing humankind. Progress on either front is

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211. See Dorf & Sabel, *supra* note 81, at 381–82 (discussing the effectiveness of local governmental management in regulating use of toxics under Massachusetts state law); Craig et al., *Balancing Stability and Flexibility*, *supra* note 73 (discussing the tension between the role of law in providing stability and the need for flexibility when managing systems undergoing change); Craig et al., *Stability and Flexibility*, *supra* note 73, at 174–75 (discussing the mechanisms available to balance stability and flexibility in government); Soininen & Platjouw, *supra* note 146, at 36–41 (discussing the effectiveness of EU conservation efforts given delegation of implementation decisions to individual member states, while reserving enforcement power for the Commission).

212. See Cosens et al., *Role of Law*, *supra* note 189 (discussing the need for agency authority to network across sectors and with private actors while maintaining legitimacy, accountability, equity and justice); Cosens et al., *Legal Pathways*, *supra* note 189, at 153 (“[I]n trading stable governmental control for innovative adaptive governance, the engagement of private actors in governance should not come at the expense of legitimacy, accountability, equity, and justice.”).

dangerously behind the rate of change.<sup>213</sup> The situation calls for the modern equivalent of the race to the moon—that is, governmental leadership in focusing, catalyzing, and accelerating innovation.<sup>214</sup> Government assistance should provide avenues for pooling and disseminating data and capacity building in the form of both funding and knowledge.

Capacity building is also essential to address the concern that greater private participation in governance and the devolution of implementation to local levels may lead to capture by more powerful interests, marginalization of certain populations, and simply local problems in the form of lack of time, money and knowledge to act, and participation fatigue.<sup>215</sup> Bevir notes that “[a]dvocates of more participatory democracy are often acutely aware that different citizens possess different resources for participating. Hence they often attend carefully to process issues about who participates in what ways and under what circumstances. So, for example, they might advocate state support for under-represented groups.”<sup>216</sup> In keeping with the focus on the historical context of decentered theory, marginalization may be of particular concern for populations suffering the legacy effects of past discrimination (e.g., Indigenous peoples in the Pacific Northwest and Scandinavia and African Americans in the many parts of the United States).<sup>217</sup> Judicial review on inclusion is essential to assure equitable participatory processes.

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213. See Vandenberg & Gilligan, *supra* note 118, at 234 (“The depth of the political barriers, however, suggests that adoption and implementation of a carbon price at the national and international levels over the next decade is a long shot.”); see, e.g., David W. Stahle, *Anthropogenic Megadrought: Human-Driven Climate Warming Worsens an Otherwise Moderate Drought*, 368 SCIENCE 238, 238–39 (2020) (explaining that Southwestern North America recently underwent its second-driest spell in twelve hundred years).

214. See, e.g., MAZZUCATO, VALUE, *supra* note 210, at 244 (“[Public institutions] must think big and play a full part in the great transformations to come, squaring up to the issues of climate change, ageing populations and the need for twenty-first-century infrastructure and innovation.”); RETHINKING CAPITALISM: ECONOMICS AND POLICY FOR SUSTAINABLE AND INCLUSIVE GROWTH, *supra* note 210, at 34 (“[I]nnovation also needs well-funded public research and development institutions and strong industrial policies. These need to be directed across the entire innovation chain, not only in the classic ‘public good’ area of basic science.”); MAZZUCATO, ENTREPRENEURIAL, *supra* note 210, at 27 (“[W]e have instead is a case for a targeted, proactive, *entrepreneurial* State, one able to take risks and create a highly networked system of actors that harness the best of the private sector for the national good . . . the State acting as lead investor and catalyst . . .”).

215. BEVIR, KEY CONCEPTS, *supra* note 9, at 29; see Cosens, *Legitimacy*, *supra* note 149.

216. BEVIR, KEY CONCEPTS, *supra* note 9, at 29.

217. See Craig Anthony (Tony) Arnold, Olivia Odom Green, Daniel DeCaro, Alexandra Chase & Jennifer-Grace Ewa, *The Social-Ecological Resilience of an Eastern Urban-Suburban Watershed: The Anacostia River Basin*, 51 IDAHO L. REV. 29, 68 (2014) (“[R]estoration projects in Washington D.C. may actually be a continuation of earlier economic and environmental injustices thinly veiled behind the rhetoric of environmental sustainability. . . . African American stakeholders continue to be marginalized and exploited under the guise of the Anacostia Riverfront Initiative.”); Craig Anthony (Tony) Arnold, Olivia Odom Green, Daniel DeCaro, Alexandra Chase

*Governmental adaptive capacity.* Adaptive capacity in government requires that (1) governmental agencies have the authority to (a) implement adaptive management,<sup>218</sup> adaptive planning,<sup>219</sup> and resilience assessment,<sup>220</sup> (b) the resources to monitor current change and produce modeled knowledge of future change, and (c) the authority to change course if the data, models or the changes in networked, collaborative, or private governance indicate a need to do so; and (2) the ability of law and policy to adapt—that is, adaptive law.<sup>221</sup> In a nested system of government, the level closest to the problem must have flexibility in implementation with public participation as the means to ensure legitimacy in the exercise of that flexibility but no discretion to adjust the goals or standards other than the political process at a higher level of government. The executive (agency) branch at the level establishing the law or goals (state or federal) must not have the discretion to interfere with innovation in implementation beyond assuring a relation to the goal and absence of corruption. This level, however, requires the authority to adjust the policy guiding implementation within a degree of authorized flexibility (i.e., adaptive law). This nested process reflects a broader scope of flexibility at higher and higher levels but also greater thresholds reflecting feedback of

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& Jennifer-Grace Ewa, *Resilience of the Anacostia River Basin: Institutional, Social, and Ecological Dynamics*, in PRACTICAL PANARCHY, *supra* note 9, at 33, 33 (“[M]ajor drivers of regime shifts from presettlement to the present are . . . patterns of structural inequality, oppression, discrimination, and movements to seek social and environmental justice . . .”); Cosens & Fremier, *supra* note 21, at 113 (“[T]he cultural importance of salmon to human inhabitants of the Basin during the Pre-Contact Era and the devastating impacts on that culture in the Post-Contact and Dam Building Eras . . . remain as an added layer of complexity in those subsequent eras . . .”); Barbara Cosens & Alex Fremier, *Social-Ecological Resilience in the Columbia River Basin: The Role of Law and Governance*, in PRACTICAL PANARCHY, *supra* note 9, at 47 (“[D]ams are a major factor in the decline of populations of salmon and steelhead species that are critical to the culture of Indigenous peoples.”).

218. See ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT, *supra* note 144; Gunderson & Light, *supra* note 40 at 328–29 (describing the problems associated with not allowing entities (including governmental agencies) to make decisions based on an evolving understanding of the problem or the circumstances); Craig & Ruhl, *supra* note 148, at 10 (developing a model administrative rule for adaptive management).

219. See Craig Anthony (Tony) Arnold, *Adaptive Watershed Planning and Climate Change*, 5 ENV'T & ENERGY L. & POL'Y J. 417, 440–49 (2010) (describing the general characteristic and factors of adaptive planning).

220. *Wayfinder: A Resilience Guide for Navigating Towards Sustainable Futures*, WAYFINDER, <https://wayfinder.earth> (last visited Sept. 26, 2020) [<https://perma.cc/FFG2-2KHS>].

221. See Ruhl & Katz, *supra* note 45, at 208 (“Law itself is a complex adaptive system, and it necessarily influences and is influenced by the systems it is intended to regulate or manage.”); Ruhl et al., *supra* note 76, at 1377 (“Efforts to integrate CAS approaches to regulated systems may flounder if complex adaptive characteristics of the legal system itself are not taken into account.”).

information from multiple sources before adjustment is made. Scholars describe this type of process as triple loop learning.<sup>222</sup> Adaptive management and innovation in implementation represents the inner loop in which feedback from monitoring allows adjustment of management measures, feedback from multiple efforts to innovate in implementation feeds back to allow adjustment in goals and policy (double loop learning), and feedback from political efforts to adjust policy and goals allows revisiting of the underlying beliefs and values that led to the legislation (triple loop learning).<sup>223</sup>

*Government steering: process and oversight.* As the role of private stakeholders in governance increases with mounting complexity, government is essential to assure good governance.<sup>224</sup> Twentieth-century bureaucracies gained legitimacy by basing decisions on science, but the degree of scientific uncertainty associated with increasing complexity has eroded trust in science-based decisionmaking. Irreducible uncertainty is often resolved through value-based judgements that can gain legitimacy only through open, transparent, and participatory processes. Thus, a critical role for government in adaptive governance is to provide oversight on the process for lower-level public-private actions and judicial review in cases of alleged corruption.<sup>225</sup> In addition, the point of judicial review, while remaining important on the front end of major projects, should not be used to create gridlock through a battle of experts faced with uncertainty. Judicial review of agency decisionmaking under the U.S. Administrative Procedure Act can gridlock efforts to solve complex problems.<sup>226</sup> As recommended by Dorf and Sabel, shifting the focus of review to back-end review of progress toward goals will allow adaptation in the face of uncertainty to proceed.<sup>227</sup> Democratic experimentalism contemplates review based on the tie between the remedy and the goal, outcomes, and violation of individual rights.<sup>228</sup> It replaces review based on agency process with review of corruption involving inclusion in networked and collaborative governance.<sup>229</sup>

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222. See Claudia Pahl-Wostl, A Conceptual Framework for Analysing Adaptive Capacity and Multi-level Learning Processes in Resource Governance Regimes, 19 GLOB. ENV'T CHANGE 354, 354 (2009).

223. See *id.* at 358–59 (2009).

224. BEVIR, KEY CONCEPTS, *supra* note 9, at 92–96.

225. Dorf & Sabel, *supra* note 81, at 399.

226. *Id.* at 439, 443.

227. *Id.* at 288, 399–400, 403.

228. *Id.* at 288, 398–400.

229. *Id.* at 399.

2020]

*ENABLING ADAPTIVE GOVERNANCE*

1731

Government process must also provide an avenue for institutionalization of collaborative solutions. Because adaptive governance emerges at the problem scale following a disturbance, no authorizing legislation exists. The tendency of society and its elected officials to lose interest when the crisis wanes leaves those who devoted years to developing collaborative solutions without the means to implement them.<sup>230</sup> A role for higher-level government agencies may be to provide a conduit for review of collaborative solutions to ensure legitimacy, inclusion, and relation to problem and a springboard for grant funding or legislation to institutionalize the solution.

Finally, it is critical to re-emphasize that adaptive governance, even in its most generalized definition, is not a panacea. Building on the AWG Project's work, AWG 2.0<sup>231</sup> explored the question of: When is government facilitation of adaptive governance appropriate? Coming full circle to the discussion of complexity in Part I, the simplest answer is that it is appropriate in situations of complexity and particularly appropriate to maintain key attributes of good governance in emergent adaptive governance efforts responding to wicked problems. In this context, government provides a toolbox for maintaining the efficacy of governance by assuring that environmental policy has a chance to reach the set goals in a feasible timeframe while adhering to good governance.

## CONCLUSION

The interdisciplinary exercise of turning to complexity science and political science to develop a deeper understanding of what types of governance are needed for society to navigate accelerating change provides a view of the role of government and law in governance innovations already emerging and proving successful. The potential for nonlinear behavior in complex systems ranging from nature to economies, and the high level of uncertainty associated with when and how it might occur, calls for governance in which those who govern are actively engaged in learning and adjustment. Even the laws under which they govern must be adaptive. In the face of accelerating change, leaving adaptive governance to emergent processes without the reform needed to bring government in line with its emergence will be too little,

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230. See, e.g., Chaffin et al., *Resilience*, *supra* note 208, at 191 (questioning whether solutions devised in response to a crisis could continue to work without being institutionalized); Chaffin et al., *Klamath River Basin*, *supra* note 208, at 93–96 (noting the failure to implement agreements regarding the Klamath River Basin after years of negotiation).

231. For background see the authors' footnote.

too late. Only if the law itself evolves as “adaptive law” will it keep pace with accelerating change and help society navigate these changes. In short, society has become “too complex, diverse, and particular[ized] for centralized, top-down governance to manage.”<sup>232</sup> Our era of modern wicked problems requires an adaptive governance approach.

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232. Burris et al., *supra* note 10, at 6.