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Environmental Law, Episode IV: A New Hope? Can Environmental Law Adapt for Resilient Communities and Ecosystems?

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Environmental Law, Episode IV: A New Hope? Can Environmental Law Adapt for Resilient Communities and Ecosystems?[*]

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[*] Keynote Speech, *Environmental Law 4.0: Adaptive and Resilient* Symposium, University of Missouri School of Law, Columbia, Missouri. Cf. George Lucas, STAR WARS: EPISODE IV: A NEW HOPE (Lucasfilm and Twentieth Century Fox Film Corporation, 1977 & 1981 re-release).

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ENVIRONMENTAL LAW, EPISODE IV: A NEW HOPE?

I. INTRODUCTION

> *It is a period of uncertainty and change. Climate change is threatening communities and ecosystems. The old regimes are fragmented, divided, only partially effective. They falter in the face of drought, flood, invasive species, polluted runoff, and land-development pressures. The landscapes of forests, farms, and cities are changing, even shifting. Restorations of ecosystems fail. Injustices persist. Systems become rigid and inflexible.*
>
> *Meanwhile, a new force for adaptation and social-ecological resilience slowly emerges and evolves. Can it help communities and ecosystems be more resilient? Is this new generation of environmental law our hope for a better future?*

I sat eagerly awaiting the movie's start in 1977. From the beginning title frame, the powerful, soaring, heroic brass fanfare of the movie's theme song signaled a sense of hope and courage. The world of *Star Wars: Episode IV: A New Hope*[1] was a dark one, dominated by power-greedy forces of oppression, planetary destruction, self-indulgent lawlessness, and a republic that had collapsed under the weight of its bureaucracy and special interests. I was a twelve-year-old Kansas boy facing the uncertainties of adolescence and of a post-Watergate Cold-War world characterized by pollution and fears over nuclear power, population growth, and climate change. The *Star Wars* movie was about a renewed hope for a resistance movement that was fighting for life-affirming good over evil and death. The new hope came from a young learn-as-you-go Jedi knight, a tough-as-nails princess, a mercenary-turned-hero pilot, and a host of others resiliently facing overwhelming obstacles. While some people may perceive climate change as a coming Death Star that will annihilate our planet,[2] I think that the better metaphor to

[1] George Lucas, STAR WARS: EPISODE IV: A NEW HOPE (Lucasfilm and Twentieth Century Fox Film Corporation, 1977 & 1981 re-release).

[2] *Cf.* Yes! Online staff, *Darth Vader's Death Star Created Jobs, Too! New Video Pokes Fun at Keystone Pipeline Claims*, YES! MAGAZINE ONLINE (Feb. 7, 2014) http://www.yesmagazine.org/planet/new-video-pokes-fun-at-keystone-pipeline-claims.

be drawn from *Star Wars: Episode IV: A New Hope* is about new generations adaptively fighting for good with renewed hope for a resilient future.

For decades, environmental law in the United States has been seeking to protect people and nature against human behaviors and systemic structures that would harm the environment. Richard Lazarus has argued that environmental law has become middle-aged, grey, and in need of renewal.[3] Environmental law evolves, though, and new generations of environmental protection regimes emerge to address problems unaddressed or inadequately addressed by earlier generations.[4]

The latest iteration of U.S. environmental law is what I call its "fourth generation."[5] It focuses on adaptive environmental governance and the resilience of interconnected ecosystems and human communities, a concept known as "social-ecological resilience."[6] However, environmental law has many maladaptive features; in general, it aims to rigidly impose front-end prescriptions on government actions and human behaviors to protect what is erroneously assumed to be a stable state of nature.[7] These characteristics are ill-suited to the uncertainties and nonlinear dynamics of complexly linked social and ecological systems, which can exist in many different stable states and which can collapse and reorganize suddenly and unexpectedly.[8]

Earth That Was, http://tvtropes.org/pmwiki/pmwiki.php/Main/EarthThatWas/

[3] Richard J. Lazarus, *The Greening of America and the Graying of United States Environmental Law: Reflections on Environmental Law's First Three Decades in the United States*, 20 VA. ENVTL. L.J. 75, 104 (2001). For a more thorough analysis of the aging of U.S. environmental law, see generally RICHARD LAZARUS, THE MAKING OF ENVIRONMENTAL LAW (2004).

[4] *See generally* Craig Anthony (Tony) Arnold, *Fourth-Generation Environmental Law: Integrationist and Multimodal*, 35 WM. & MARY ENVTL. L. & POL'Y REV. 771 (2011).

[5] *Id.* at 775.

[6] *Id.* (exploring the emergent use of integrated multimodal methods of environmental protection to address complex, dynamic, interconnected ecological and social problems). The framing of fourth-generation environmental law as a phenomenon of adaptive governance for social-ecological resilience was more fully developed in Craig Anthony (Tony) Arnold & Lance H. Gunderson, *Adaptive Law and Resilience*, 43 ENVTL. L. REP. 10426 (2013).

[7] Arnold, *Fourth-Generation Environmental Law*, *supra* note 4, at 784-85.

[8] *Id.*

Whether environmental law can adapt to confront a non-static world of massive, complex, overwhelming environmental and societal problems[9] by building the resilience of both communities and ecosystems, is a challenging question. It is a question about whether we dare to hope when we are often disappointed in the capacity and performance of environmental law, our society, and humans generally. While there are weaknesses and limits to fourth-generation environmental law, I believe that there is much reason to hope, though. Its emergent, evolutionary, iterative characteristics are adaptive features that can help to build ecological and social resilience and that can engage diverse participants in the struggle for an environmentally responsible world.

In this article, I describe the evolution of U.S. environmental law through four generations and the characteristics of each generation. I then define resilience generally and social-ecological resilience specifically. I use examples to illustrate how systems can collapse under disturbances and shift to entirely new structures and functions, the kind of dynamics that call for improved adaptive capacity in our environmental law system. I explore this need for adaptation and adaptive capacity in the context of maladaptive features of environmental law's governance of water resources. There are five alternatives to traditionally rigid, fragmented, certainty-seeking environmental law structures: adaptation, adaptive management, adaptive planning, adaptive governance, and adaptive law. Each is described. Each is necessary.

Fortunately, adaptive environmental law and governance institutions are emerging, aimed at improving social-ecological resilience. Examples include developments in adaptive watershed governance institutions. These examples of fourth-generation environmental law suggest reasons to hope that environmental law can adapt for resilient communities and ecosystems. However, I also explore the reasons why fourth-generation environmental law might disappoint us: its inherent limits and flaws. Nonetheless, hope itself is an adaptive and resilience-building strategy. In the final section of

[9] *See generally* J. B. Ruhl & James Salzman, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: A Guide for Whittling Away*, 98 CAL. L. REV. 59 (2010).

the article, I discuss research on the psychology of hope and what it means for how we think about environmental law in the United States.

II. FOUR GENERATIONS OF U.S. ENVIRONMENTAL LAW

Most generational analyses of U.S. environmental law begin with the major federal statutes enacted in the period surrounding and following Earth Day 1970, even though environmental law existed in the U.S. before then.[10] Likewise, most generational analyses have identified at least three major generations that have arisen, starting in the late 1960s or early 1970s with modern federal environmental statutes.[11]

The first generation of U.S. environmental law was characterized by command and control regulation, what Dan Tarlock calls rule-of-law litigation[12] (including citizen suits to enforce environmental statutes), and technology-based pollution controls.[13] This generation sought to prevent harm to the environment by targeting pollution with regulatory instruments and regimes mostly developed and controlled by centralized federal agencies. The role of law in the first generation was to require compliance with rules.

The second generation arose in reaction to the rigidity and economic inefficiencies of command-and-control regulatory regimes. This generation sought to introduce regulatory flexibility, improve efficiency, and harness market incentives through cost-benefit analysis, compliance incentives,

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[10] KARL BOYD BROOKS, BEFORE EARTH DAY: THE ORIGINS OF AMERICAN ENVIRONMENTAL LAW, 1945-1970 (2009). Common law doctrines, federal land and natural-resource management laws, and early environmental statutes preceded the flurry of enactments of federal statutory and regulatory regimes in the late 1960s and early 1970s.

[11] *See generally* Jeffrey G. Miller, *A Generational History of Environmental Law and Its Grand Themes: A Near Decade of Garrison Lectures*, 19 PACE ENVTL. L. REV. 501 (2002); Richard B. Stewart, *A New Generation of Environmental Regulation?*, 29 CAP. U. L. REV. 21 (2001); Zygmunt J.B. Plater, *Environmental Law in the Political Ecosystem – Coping with the Reality of Politics*, 19 PACE ENVTL L. REV. 423, 427 n.9 (2002); A. Dan Tarlock, *The Future of Environmental "Rule of Law" Litigation*, 17 PACE ENVTL. L. REV. 237 (2000); Richard J. Lazarus, *The Greening of America and the Graying of United States Environmental Law: Reflections on Environmental Law's First Three Decades in the United States*, 20 VA. ENVTL. L.J. 75 (2001).

[12] Tarlock, *supra* note 11.

[13] Arnold, *Fourth-Generation Environmental Law*, *supra* note 4, at 790.

market tools, and flexible and negotiated rule-making.[14] The second generation's primary goal was to efficiently improve the environmental performance of businesses, individuals, and government agencies by targeting behaviors with incentives. Markets and public-private partnerships dominated second-generation environmental law, which served to facilitate alternatives to rules.

The third generation has been a mix of systemic alternatives to the regulation-dominated and market-dominated prior generations. Movements for sustainability or sustainable development, environmental justice, reflexive law, decentralized and collaborative problem solving, participatory processes, adaptive ecosystem management, and outcomes-based instrument choice have characterized environmental law's third generation.[15] This seemingly hodge-podge collection of elements has some overarching themes, though. The third generation focuses primarily on systems and making them environmentally, socially, and economically sustainable. It does so through robust participation and opportunities for public and multi-stakeholder participation, which is designed to build legitimacy for environmental protection, engage individuals and organizations in changing environmentally unsustainable or socially unjust patterns of behavior, and improve societal feedback loops into environmental management. Thus, in the third generation, decentralized collaboration is an important part of developing new rules that will guide human and societal actions towards environmental protection, social justice, and economic productivity.

A fourth generation of environmental law appears to be emerging. In some respects, this new generation is a reaction to and rejection of the prior generations' assumptions that the environment is a static good to preserve, commodify, or sustain. Based in the science of resilience and panarchy, the fourth generation recognizes natural environments and human environments as highly dynamic, shaped by complex and nonlinear interconnections among ecological systems, social systems, and institutions.[16] It aims to enhance or support the resilience of both ecosystems and human communities by

[14] *Id.* at 791.
[15] *Id.* at 791-92.
[16] *Id.* at 780-88, 792, 797-821.

focusing on the interconnections among ecosystems, social systems, and institutions (systems of systems).[17] However, the fourth generation embraces prior generations by using their tools and instruments (e.g., regulation, incentives, adaptive management, participatory processes), as well as other tools and instruments in a multimodal – or toolbox – approach.[18] It is also characterized by emergent and evolving polycentric governance systems that are loosely linked through networks and feedback, including many different kinds of federal-state partnerships, multi-stakeholder collaborative processes, litigation and regulation as stimuli to negotiated problem-solving, community-based activism, and others.[19] In the fourth generation, law is meant to stimulate and support adaptive governance, although often law actually serves as a barrier to adaptive governance.[20]

All generations are cumulative.[21] No generation has replaced any prior generation, but now all four generations share the sociopolitical and legal space that is U.S. environmental law like a sort of high-activity, diverse family gathering. Or to use the Star Wars theme, Yoda and Obi-Wan Kenobi are fighting alongside Luke Skywalker and Princess Leia. Nonetheless, the differences among these generations are important in assessing the capacity of environmental law to address the complex, even overwhelming, challenges of today and the future. The following table shows the comparisons among the four generations:

[17] *Id.* at 795-97, 866-74.
[18] *Id.* at 792-95.
[19] *Id.* at 866-874.
[20] Arnold & Gunderson, *supra* note 6, at 10427-29 & Table I.
[21] Arnold, *Fourth-Generation Environmental Law*, *supra* note 4, at 792.

Table 1: Comparisons of Four Generations of U.S. Environmental Law

Generation → Element ↓	1st Generation	2nd Generation	3rd Generation	4th Generation
Goal	Prevent harm to the environment	Efficiently improve environmental performance	Make systems (environmental, social, economic) sustainable	Enhance and support social-ecological resilience
Target	Pollution	Behavior	Systems	Interlinked systems of systems (social-ecological-institutional
Instrument	Regulation	Incentives	Participation	Multimodal (toolbox approach)
Locus of Power	Centralized government	Markets or public-private partnerships	Decentralized collaboration	Polycentric governance
Role of Law	Require compliance with rules	Facilitate alternatives to rules	Facilitate collaborative development of new rules	Stimulate and support adaptive governance

One of the primary lessons to learn from the four generations of environmental law is that environmental law evolves relatively rapidly, with new structures and frameworks (or generations) emerging in response to the inadequacies of existing structures and frameworks and to the needs created by new problems or changing conditions.[22] Changes in environmental law institutions – the rules, norms, and cognitive-cultural beliefs that shape and structure human interactions regarding the environment[23] – are influenced by the pace and magnitude of change in ecosystems, society, and other institutions.[24] They are also influenced by the complex and multidimensional nature of environmental problems,[25] and how those problems are framed by people and groups in society.[26]

III. SOCIAL-ECOLOGICAL RESILIENCE

Resilience is the capacity of a system to withstand or adapt to disturbance while maintaining its core structures and functions.[27] Resilience science shows that ecosystems can exist in a variety of stable configurations, and that social systems and ecosystems are interconnected at multiple scales in complex and dynamic ways that can produce abrupt and unexpected changes.[28] If a system's resilience degrades sufficiently, the system may

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[22] *Id.* at 773, 795-96, 797-866, 874-78.

[23] ELINOR OSTROM, UNDERSTANDING INSTITUTIONAL DIVERSITY 3 (2005); W. RICHARD SCOTT, INSTITUTIONS AND ORGANIZATIONS: IDEAS AND INTERESTS, 3RD ED. 48-59 (2008).

[24] I have developed a new framework, the Institutional-Social-Ecological Dynamics (ISED) Framework, as a tool to focus researchers on the influence of intra-institutional change, social change, and ecological change on the emergence and evolution of institutions. Craig Anthony (Tony) Arnold et al., *The Social-Ecological Resilience of an Eastern Urban-Suburban Watershed: The Anacostia River Basin*, ID. L. REV. (forthcoming 2015).

[25] Arnold, *Fourth-Generation Environmental Law*, *supra* note 4, at 773, 795-96, 797-866, 874-78.

[26] Craig Anthony (Tony) Arnold, *Framing Watersheds*, *in* ENVIRONMENTAL LAW AND CONTRASTING IDEAS OF NATURE: A CONSTRUCTIVIST APPROACH 271-302 (Keith Hirokawa, ed. 2014).

[27] BRIAN WALKER & DAVID SALT, RESILIENCE THINKING: SUSTAINING ECOSYSTEMS AND PEOPLE IN A CHANGING WORLD xiii (2006).

[28] *See generally* C.S. Holling et al., *In Quest of a Theory of Adaptive Change*, *in* PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS 3 (Lance H. Gunderson & C.S. Holling, eds., 2002) [hereinafter PANARCHY]; C.S. Holling, *Resilience and Stability of Ecological Systems*, *in* FOUNDATIONS OF ECOLOGICAL

cross the threshold that represents the limits of the system, pushing the system to suddenly collapse and transform or reorganize into a new system.[29]

Many systems move through four phases of adaptive cycles.[30] In the exploitation phase (called the "*r* phase" by scientists), the system rapidly garners and exploits resources.[31] In the conservation phase (called the "*K* phase" by scientists), the system develops functions and accumulates resources but becomes increasingly rigid and resistant to change as it does so.[32] In the release phase (called the "*omega* phase" by scientists), the system's increasing rigidity leads to decreased resilience and eventual collapse as a threshold of change is crossed, releasing energy.[33] In the reorganization phase (called the "*alpha* phase" by scientists), the system reorganizes into a new system or a reconstituted version of the prior system with rapid assembly or reassembly of system components.[34] Thus, mere resistance to change might actually decrease systemic resilience over time by making it brittle and inflexible, and thus unable to adapt to unexpected or unprecedented disturbances.

Some ecosystems' core structures, functions, and processes are defined and maintained by adaptive cycles of exploitation, conservation, release, and reorganization. An example would be prairie grasslands.[35] Native prairie grasses are highly adaptive and resilient, but they compete with woody vegetation, which emerges and increases from savannas to woodlands to forests in a pattern known as succession.[36] As tree systems increasingly

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RESILIENCE 19-20 (Lance H. Gunderson et al. eds, 2010).

[29] *See generally* DISCONTINUITIES IN ECOSYSTEMS AND OTHER COMPLEX SYSTEMS (Craig R. Allen & C.S. Holling, eds., 2008).

[30] The entire cycle, including relationships among the phases, is described at length in C.S. Holling & Lance H. Gunderson, *Resilience and Adaptive Cycles*, *in* PANARCHY, *supra* note 28, at 25, 32-49; *see also* WALKER & SALT, *supra* note 27, at 81-87.

[31] *See* sources cited *supra* note 30.

[32] *See* sources cited *supra* note 30.

[33] *See* sources cited *supra* note 30.

[34] *See* sources cited *supra* note 30.

[35] Garry D. Peterson, *Quasi-Alternate States*, *in* Holling & Gunderson, *supra* note 30, at 42, Box 2-4.

[36] *Id.*; O.J. REICHMAN, KONZA PRAIRIE: A TALLGRASS NATURAL HISTORY 49-51, 104-13, 116-18 (1988).

conserve and consume space and energy on the prairie, disturbances are needed periodically to eliminate the trees and return energy, including nutrients, to the soils where prairie grasses once again will thrive.[37] The most significant of these disturbances are wildfires, drought, floods, and wildlife grazing, trampling, and wallowing.

In other cases, though, adaptive cycles lead to the collapse of biologically rich and well functioning systems, replaced by alternate, stable systems (or regimes) that are biologically degraded and poorly functioning. Examples include the sudden transition of clear lakes to turbid and phytoplankton-dominated states due to algae blooms, of coral reefs to algae reefs, of mixed hardwood and pine forests to forests dominated by one type or the other due to fire suppression and fuel accumulation, and species populations that decline and go extinct because habitat for recolonization has become fragmented and surrounding species' populations have become small.[38]

Fourth-generation environmental law is concerned not only with resilience in general but also with the concept of social-ecological resilience.[39] The resilience of social systems and the resilience of ecological systems are interconnected in complex, dynamic, and nonlinear relationships.[40] The resilience of human communities and social institutions depends on the resilience of natural communities and ecosystems, and vice-versa.[41] Interconnected systems affect one another across types of systems and across nested scales, often in nonlinear relationships.[42]

For example, fire suppression on federal public lands has protected human safety and property but led to the accumulation of fuel producing fires

[37] Peterson, *supra* note 35, at 42, Box 2-4; REICHMAN, *supra* note 36, at 49-51, 104-13, 116-18.

[38] Garry D. Peterson, *Alternative Stable States*, *in* Holling & Gunderson, *supra* note 30, at 36-37, Box 2-2.

[39] *See generally* SOCIAL-ECOLOGICAL RESILIENCE AND LAW (Ahjond S. Garmestani & Craig R. Allen, eds., 2014).

[40] Arnold & Gunderson, *supra* note 6, at 10428-32.

[41] *Id.* at 14031.

[42] *See generally* PANARCHY, *supra* note 28 (discussing throughout the book linked adaptive cycles across types and nested scales of systems).

of unprecedented extent and cost.[43] Ecosystems, human communities, and social institutions in the New Orleans area fundamentally changed during and after Hurricane Katrina, due primarily to the interplay of altered coastal wetlands systems, failed engineered levee systems, inadequate disaster planning and response systems, ill-conceived land use planning, structural racism, and socio-economic and political dynamics, among other factors.[44] A large hypoxic zone in the Gulf of Mexico, in which all biological life in a 5,000-square-mile ocean area has collapsed, is the result of nutrient runoff from farms, cities, suburbs, and wastewater treatment facilities throughout the 31-state Mississippi River Basin.[45] The societal causes and the ecological effects of the Gulf Hypoxia Zone are distant in both time and space from one another. Of course, climate change is a major cross-scale threat to the resilience of many ecosystems and human communities, as well.[46]

Given the feedbacks between social systems and ecosystems, fourth-generation environmental law seeks to strengthen the resilience of both

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[43] C.S. Holling, *The Resilience of Terrestrial Ecosystems: Local Surprise and Global Change*, *in* FOUNDATIONS OF ECOLOGICAL RESILIENCE 67, 83 (Lance H. Gunderson et al. eds., 2010).

[44] *See* Lance Gunderson, *Ecological and Human Community Resilience in Response to Natural Disasters*, 15 ECOLOGY & SOC'Y 18, 18 (2010), *available at* http://www.ecologyandsociety.org/vol15/iss2/; Colin D. Woodroffe et al., *Landscape Variability and the Response of Asian Megadeltas to Environmental Change*, *in* GLOBAL CHANGE AND INTEGRATED COASTAL MANAGEMENT: THE ASIA-PACIFIC REGION 277, 308 (Nick Harvey ed., 2006); Robert W. Kates et al., *Reconstruction of New Orleans After Hurricane Katrina: A Research Perspective*, 103 PROC. NAT'L ACAD. SCI. U.S. AM. 14653, 14654–55 (2006), *available at* http://www.pnas.org/content/103/40/14653.full.pdf+html?sid=31c060e1-7c6c-4fc2-bbdb-11a7c63bf3f0; CTR. FOR PROGRESSIVE REFORM, AN UNNATURAL DISASTER: THE AFTERMATH OF HURRICANE KATRINA 1 (2005), *available at* http://www.progressivereform.org/articles/Unnatural_Disaster_512.pdf; Manuel Pastor et al., *Environment, Disaster and Race After Katrina*, 13 RACE, POVERTY & THE ENV'T., no. 1, 2006 at 21, 21–22, *available at* http://reimaginerpe.org/files/Pastor.Bullard.etc.Env.Katrina.pdf.

[45] Ruhl & Salzman, *supra* note 9, at 60; Mississippi River Gulf of Mexico Watershed Nutrient Task Force, *Northern Gulf of Mexico Hypoxic Zone*, WATER.EPA.GOV, http://water.epa.gov/type/watersheds/named/msbasin/zone.cfm (last visited Oct. 3, 2014).

[46] *See generally* Alejandro E. Camacho & T. Douglas Beard, *Maintaining Resilience in the Face of Climate Change*, *in* SOCIAL-ECOLOGICAL RESILIENCE AND LAW, *supra* note 39, at 235-238.

ecosystems and human communities by strengthening their adaptive capacity.[47] A resilient system has enough flexibility, redundancy, and learning capacity to adapt to disturbances and surprises without collapsing or flipping into a fundamentally different system.[48]

However, resilience is not always a normatively desirable goal. Science does not dictate maintaining the resilience of any particular systems, because systems can function in more than one state and disturbances will inevitably force at least some changes to systems.[49] Normatively, we do not want to enhance or even maintain the resilience of some systems, such as brutal dictatorships, patterns of injustice, landscapes or waterscapes dominated by aggressive invasive species (e.g., kudzu, Asian carp), or environmentally harmful consumer behaviors. Moreover, rigid legal systems can preserve their status quo by resisting change while simultaneously undermining the resilience and functions of ecosystems and other institutions.[50]

Nonetheless, society values the resilience of many ecosystems and human communities. We desire that democracy, just laws, native ecosystems, and local economies thrive and be resilient to disturbances. Waters teeming with aquatic life are preferable to turbid or eutrophic waters. Increasingly, social-ecological resilience is replacing sustainability as the primary desired policy goal of environmental law and related fields of law and policy.[51]

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[47] *See* Steve Egger, *Determining a Sustainable City Model*, 21 ENVTL. MODELLING & SOFTWARE 1235, 1237–39 (2006), *available at* http://www.sciencedirect.com/science/article/pii/S1364815205001313#.

[48] *See id.*

[49] *See generally id.* (discussing the various disturbances experienced by resilient cities); WALKER & SALT, *supra* note 27 (discussing change as an action of resiliency); DISCONTINUITIES IN ECOSYSTEMS AND OTHER COMPLEX SYSTEMS, *supra* note 29 (discussing ecosystems' adaptations to change by collapsing and transforming into new systems).

[50] *See generally* Sandra Zellmer & Lance Gunderson, *Why Resilience May Not Always Be a Good Thing: Lessons in Ecosystem Restoration from Glen Canyon and the Everglades*, 87 NEB. L. REV. 893, 895 (2009).

[51] Robin Kundis Craig & Melinda Harm Benson, *Replacing Sustainability*, 46 AKRON L. REV. 841, 862 (2013).

IV. ENVIRONMENTAL LAW'S ADAPTIVE CAPACITY

A. The Adaptive Capacity Imperative and the Maladaptive Reality

Systemic complexity, dynamics, uncertainty, and limits create the need for adaptive capacity in environmental law for social-ecological resilience.[52] Ecosystems, social systems, and institutions are interconnected across systems and scales in complex, nonlinear relationships with strong inter-system and inter-scale feedbacks; assumptions of simple, linear relationships form inadequate, maladaptive legal and policy frameworks.[53] Human and natural environments – including human communities – not only experience changes that are fast-paced, widespread, and intense in impact, but they also are subject to disturbances that push them past threshold tipping points into systemic collapse and reorganization, and legal and policy failure.[54] Future conditions are uncertain; the idea that environmental or resource systems operate within a fixed range of historically observable parameters ("stationarity") is no longer a valid assumption on which to base management or governance decisions.[55] Moreover, all systems have limits. The capacity of environmental law and governance is constrained not only by ecosystem structures and processes but also by the limited capacity of human cognition and predictive ability, social and behavioral processes, organizations, and institutions.[56]

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[52] Arnold, *Fourth-Generation Environmental Law*, *supra* note 4, at 780-788, 792, 797-821; Arnold & Gunderson, *supra* note 6, at 10428-10432.

[53] *See generally* WALKER & SALT, *supra* note 27; PANARCHY, *supra* note 28, and DISCONTINUITIES, *supra* note 29.

[54] *See generally* WALKER & SALT, *supra* note 27; PANARCHY, *supra* note 28, and DISCONTINUITIES, *supra* note 29.

[55] Robin Kundis Craig, "*Stationarity Is Dead"—Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 HARV. ENVTL. L. REV. 9, 68 (2010); P.C.D. Milly et al., *Stationarity is Dead: Whither Water Management*, 319 SCI. 573 (2008).

[56] *See* JAMES G. MARCH, DECISIONS AND ORGANIZATIONS (1988); JAMES G. MARCH & HERBERT A. SIMON, ORGANIZATIONS 203–10 (1958); JUDGMENT UNDER UNCERTAINTY: HEURISTICS AND BIASES (Daniel Kahneman et al. eds., 1982); Christine Jolls et al., *A Behavioral Approach to Law and Economics*, 50 STAN. L. REV. 1471, 1545 (1998); Charles E. Lindblom, *The Science of "Muddling Through,"* 19 PUB. ADMIN. REV. 79 (1959); Denise Lach et al., *Maintaining the Status Quo: How Institutional Norms and Practices Create Conservative Water Organizations*, 83 TEX. L. REV. 2027 (2005); David Feldman & Helen

Many aspects of U.S. environmental law are maladaptive, as illustrated by problems in the environmental protection and management of water.[57] The environmental protection and management of water is highly fragmented across a dozen different legal regimes or systems: surface water rights, groundwater rights, point source pollution controls, urban nopoint source pollution and runoff controls, rural and agricultural nonpoint source pollution controls, wetlands protection, land use planning and regulation, protection of endangered species and their habitats, navigation and recreation management, water development projects, flood management, and energy law and policy.[58] In many cases, this fragmentation is not an adaptive structure of polycentricity and modularity, but instead a set of hard, impermeable, organizational and institutional silos that prevent coordination or integration of laws and policies across systems and scales.[59]

The environmental protection and management of water is also characterized by rigid rules and either/or classifications.[60] Once a set of human or organizational actions are determined to have an adverse effect on federally listed endangered or threatened species or their habitat (e.g., species with aquatic habitats), a set of relatively rigid prohibitions and administrative procedures apply, but the law does not prevent degradation of waterways that could lead to the decline of currently healthy species populations, nor require proactive strategies to strengthen the resilience of aquatic systems.[61] Federal jurisdiction under the Clean Water Act, with its regulatory constraints on development, either fully applies to a particular waterway or wetland, or it does not apply to it at all.[62] "All water transfers between water bodies require a National Pollution Discharge Elimination System ("NPDES") permit or none do under the 'unitary waters' rule."[63] The Clean Water Act

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Ingram, *Making Science Useful to Decision Makers: Climate Forecasts, Water Management, and Knowledge Networks*, 1 WEATHER, CLIMATE, & SOC'Y 9, 10 (2009).

[57] Craig Anthony (Tony) Arnold, *Adaptive Water Law*, 62 KAN. L. REV. 1043, 1043-1049, 1054-65 (2014).

[58] *Id.* at 1060-65.

[59] *Id.* at 1064-65.

[60] *Id.* at 1057-59.

[61] *Id.* at 1059.

[62] *Id.* at 1058.

[63] *Id.*

treats point sources and nonpoint sources quite differently.[64] These either/or classifications constrain the flexibility of both regulatory agencies and regulated parties.

Moreover, the law's rigidity often intersects with the law's attempt to provide people, businesses, and organizations with certainty and security. Several different kinds of decisions – habitat conservation plans under the Endangered Species Act, environmental impact statements under the National Environmental Policy Act, and the setting of Total Maximum Daily Loads for impaired water bodies under the Clean Water Act – "pre-commit agencies and regulated parties to actions and project features that may not be well-suited to future conditions, synergistic disturbances, or unexpected transitions from one ecosystem state to another."[65] Likewise, water quality permits, water rights, and land-use permits often have perpetual terms and conditions that were established based on a set of conditions at a fixed point in time (with perhaps some inadequate predictions about future conditions), and might not ever be revisited and revised if conditions change.[66] These statutory and regulatory frameworks attempt to impose, often relatively rigidly, certainty and security about future actions and arrangements. Moreover, the takings doctrine either guarantees property owners that existing property rights and allocations will not change or that they will be compensated if there is a necessary legal change.[67] The law's promises that current arrangements are secure and certain are illusory, as resilience science demonstrates. The law's creation of what are essentially insurance schemes against the risk of inevitable change deter the benefited parties from reducing their risk, adapting to change, or improving their adaptive capacity.[68]

Developments in environmental law in recent years, though, show some promise of legal change towards increased adaptive capacity and social-ecological resilience. In particular, environmental law can strengthen or facilitate the adaptive capacity of ecosystems and human communities

[64] *Id.*
[65] *Id.* at 1059.
[66] *Id.* at 1056.
[67] *Id.* at 1055.
[68] *Id.* at 1055-57.

through each of five approaches: adaptation, adaptive management, adaptive planning, adaptive law, and adaptive governance.

B. Adaptation

"Adaptation is a process of deliberate change in anticipation of or in reaction to external stimuli and stress."[69] A resilience-based (or systems-based) approach to adaptation emphasizes the intersection of human responses that aim to reduce vulnerabilities and respond to environmental change with systemic features of adaptive capacity, learning capacity, and transformational capacity.[70] In other words, successful adaptation requires the development of adaptive capacity in institutions, communities, and societies.

Climate change gets particular attention as the kind of environmental change to which humans must adapt. The Intergovernmental Panel on Climate Change defines adaptation as "adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. This term refers to changes in processes, practices, or structures to moderate or offset potential damages or to take advantage of opportunities associated with changes in climate. It involves adjustments to reduce the vulnerability of communities, regions, or activities to climatic change and variability."[71] Adaptation is a dominant policy response to climate change.[72]

Legal scholars have addressed the relationships between environmental law and adaptation, particularly in the context of climate

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[69] Donald R. Nelson et al., *Adaptation to Environmental Change: Contributions of a Resilience Framework*, 32 ANN. REV. ENVTL. RES. 395, 395 (2007).

[70] *Id.*

[71] JAMES J. MCCARTHY ET AL., CLIMATE CHANGE 2001: IMPACTS, ADAPTATION, VULNERABILITY 643 (2001).

[72] *See, e.g.*, WILLIAM E. EASTERING III, BRIAN H. HURD & JOEL B. SMITH, PEW CENTER ON GLOBAL CLIMATE CHANGE, COPING WITH GLOBAL CLIMATE CHANGE: THE ROLE OF ADAPTATION IN THE UNITED STATES (2004), *available at* http://www.pewclimate.org/docUploads/Adaptation%2Epdf; Robert Mendelsohn, *Efficient Adaptation to Climate Change*, 45 CLIMATIC CHANGE 583 (2000).

change.[73] Climate change will necessitate adaptation by coastal communities to sea-level rise and changing intensities and frequencies of hurricanes and storm surge, whether these responses involve armoring, beach renourishment programs, new land-development codes, dune and vegetation restoration, or retreat strategies.[74] Changing precipitation and temperature patterns in the American West will require new policies and rules regarding water usage, water transfers, risk management for public water supplies and agricultural water supplies, instream flow protection and management, and protection of aquatic species.[75]

Nonetheless, adaptation strategies have significant limits. They may distract policymakers, resource users, and the public from taking steps to mitigate the causes of climate change, particularly the production of greenhouse gases.[76] They may overestimate scientific knowledge and institutional performance in achieving effective adaptation and underestimate distributional inequities in the capacity to adapt and the effects of adaptation actions.[77] They may themselves create adverse impacts on the environment,

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[73] *See, e.g.*, MICHAEL B. GERRARD & KATRINA FISCHER KUH, THE LAW OF ADAPTATION TO CLIMATE CHANGE: UNITED STATES AND INTERNATIONAL ASPECTS (2012); J.B. Ruhl, *Climate Change Adaptation and the Structural Transformation of Environmental Law*, 40 ENVTL. L. 363 (2010); Craig, *Stationarity Is Dead*, *supra* note 55; Raina Wagner, *Adapting Environmental Justice: In the Age of Climate Change, Environmental Justice Demands a Combined Adaptation-Mitigation Response*, 2 ARIZ. J. ENVTL. L. & POL'Y 153 (2012); Victor B. Flatt, *Adapting Laws for a Changing World: A Systemic Approach to Climate Change Adaptation*, 64 FLA. L. REV. 269 (2012).

[74] Craig Anthony (Tony) Arnold, *Legal Castles in the Sand: The Evolution of Property Law, Culture, and Ecology in Coastal Lands*, 61 SYRACUSE L. REV. 213, 228-48 (2011). For a collection of adaptation plans for coastal communities in the United States, see National Oceanic and Atmospheric Administration, Coastal Climate Adaptation, Adaptation/Action Plans, http://collaborate.csc.noaa.gov/climateadaptation/Lists/Resources/AdaptationAction%20Plans.aspx.

[75] *See generally* Holly Doremus & Michael Hanemann, *The Challenges of Dynamic Water Management in the American West*, 26 UCLA J. ENVTL. L. & POL'Y 55 (2008).

[76] Ruhl, *Climate Change Adaptation*, *supra* note 73, at 365-68.

[77] A. Dan Tarlock, *Now, Think Again About Adaptation*, 9 ARIZ. J. INT'L & COMP. L. 169, 170-71 (1992).

even exacerbating the problems of climate change.[78] From a resilience perspective, adaptation strategies could be too narrow. Although J.B. Ruhl argues for systemic transformations that increase the adaptive capacity of legal and governance institutions, human communities, and ecosystems to navigate instability and change – such as multiscalar governance networks, transition-based resource strategies, more integration of land use, water law, and environmental law, enhanced flexibility in regulatory instruments, property rights, and liability rules, and shifts from up-front planning to back-end adaptive management methods[79] – he acknowledges that adaptation strategies could be limited to proactive risk reduction strategies, such as "crop and livelihood diversification, seasonal climate forecasting, community-based disaster risk reduction, famine early warning systems, insurance, water storage, [and] supplementary irrigation,"[80] or even reactive responses to climate change, such as "emergency response, disaster recovery, and migration."[81]

C. Adaptive Management

A second adaptive approach of fourth-generation environmental law is adaptive management.[82] Adaptive management is a method of managing natural resources or ecosystems as a flexible, continuous set of experiments or learning processes, under conditions of uncertainty and incomplete knowledge, with feedback loops that lead to adjustments in management actions.[83] This management system, with its iterative processes, assumes that

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[78] Matthew D. Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 ECOLOGY L.Q. 61, 63 (2007).

[79] Ruhl, *Climate Change Adaptation*, *supra* note 73, at 378.

[80] *Id.* at 383 (internal citation omitted).

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

[82] The concept of adaptive management was developed by C.S. "Buzz" Holling. For the classic work on adaptive management, see generally ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (C.S. Holling ed., 1978).

[83] *See, e.g.*, Bradley C. Karkkainen, *Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward a Bounded Pragmatism*, 87 MINN. L. REV. 943, 946-56 (2003); Holly Doremus, *Precaution, Science, and Learning While Doing in Natural Resource Management*, 82 WASH. L. REV. 547, 568-79 (2007); Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1, 16-24 (2009); Robert L. Glicksman, *Ecosystem Resilience to Disruptions*

all knowledge is provisional and that resource management is a series of experiments that have feedback loops consisting of continuous monitoring, learning, and changes to management actions based on the lessons learned.[84] Instead of planning all actions on the front end based on extensive and detailed pre-action study with its forecasts of the future, analyses of options, and selection of preferred goals and strategies, adaptive management of resources and environments evolves as managers learn while doing.[85]

Adaptive management is a popular concept in environmental and resource management, but is practiced poorly or incompletely.[86] A frequent complaint is that the legal system, with its up-front prescriptive requirements and planning processes and back-end liabilities for failed management actions, deters officials from using adaptive management in actual practice.[87] Skeptics argue, though, that major revisions to environmental law to authorize or accommodate adaptive management are too uncertain to produce positive environmental outcomes, and too likely to produce negative environmental outcomes.[88] Moreover adaptive management focuses narrowly on management actions taken by resource management officials. Adopting adaptive management strategies does not increase flexibility or adaptive capacity in the laws, governance systems, or institutions that set broad public policies and define the sociopolitical boundaries and space in

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Linked to Global Climate Change: An Adaptive Approach to Federal Land Management, 87 NEB. L. REV. 833, 865-91 (2008); Robin Kundis Craig & J.B. Ruhl, *Designing Administrative Law for Adaptive Management*, 67 VAND. L. REV. 1, 16-26 (2014).

[84] *See* ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT, *supra* note 82.

[85] Doremus, *supra* note 83, at 547.

[86] Camacho, *supra* note 83, at 25-36; Melinda Harm Benson, *Adaptive Management Approaches by Resource Management Agencies in the United States: Implications for Energy Development in the Interior West*, 28 J. ENERGY & NAT. RESOURCES L. 87, 88, 104-117 (2010); J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L. REV. 424, 424, 426 (2010).

[87] *See generally* J.B. Ruhl, *Regulation by Adaptive Management – Is It Possible?*, 7 MINN. J.L. SCI. & TECH. 21 (2005). For a more nuanced perspective, see Ruhl and Fischman, *supra* note 86, at 427 (concluding that courts are enthusiastic about adaptive management in theory but often dissatisfied with agencies' poor crafting of adaptive management procedures that ignore substantive legal standards).

[88] *See generally* Eric Biber, *Adaptive Management and the Future of Environmental Law*, 46 AKRON L. REV. 933 (2013).

which resources are managed. Adaptive management is not adequate by itself. Adaptive planning processes, adaptive legal frameworks, and adaptive governance institutions are needed for social-ecological resilience.

D. Adaptive Planning

Adaptive planning is an iterative and evolving process of identifying goals and making decisions about future actions that: 1) are flexible; 2) contemplate uncertainty and multiple possible scenarios; 3) include feedback loops for frequent modification to plans and their implementation; and 4) build planning, management, and governance capacity to adapt to change.[89] Adaptive planning expressly plans for the processes of ongoing planning, plan modification, and plan implementation through management actions.[90] It builds multiple iterations of feedback loops and planned decision making into the process, which are aimed at preventing a single set of goals and strategies from becoming rigidly ingrained in an institution or organization, and at forcing planners and decision makers to monitor and evaluate the impacts of plan implementation under changing conditions so that goals, strategies, and implementation actions can be adjusted accordingly.[91] Planning is continuous, event-driven, and feedback-driven.[92] Adaptive planning is highly participatory and relatively decentralized, pushing as many decisions as possible to smaller units that are most affected by those decisions and to those who will be implementing the plan to make at-the-time adjustments under the conditions that exist during implementation.[93] The planning process facilitates the emergence and use of self-organizing systems of planning and decision making.[94] The substantive content of the plan is highly flexible, containing multiple goals, multiple options, multiple criteria for making implementation decisions or future planning decisions,

[89] Craig Anthony (Tony) Arnold, *Adaptive Watershed Planning and Climate Change*, 5 ENVTL. & ENERGY L. & POL'Y J. 417, 440 (2010).
[90] *Id.* at 440-44.
[91] *Id.*
[92] *Id.*
[93] *Id.*
[94] *Id.*

consideration of systemic complexities and instabilities, and diversity of perspectives and knowledge.[95]

There is a robust literature on adaptive planning theory and processes;[96] it is a distinct type of planning that contrasts with conventional up-front development of comprehensive static plans.[97] Rzevski observes the following contrasts:

> (1) conventional planning seeks to form only the optimal plan, whereas adaptive planning includes as many options as practical in the plan;
>
> (2) conventional planning seeks to avoid redundancy of resources, whereas redundancy of resources is planned in adaptive planning;
>
> (3) conventional planning mandates that the plan be followed for a specified time, whereas adaptive planning provides for the continuous modification of the plan to accommodate changes in the operational environment;

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[95] *Id.*

[96] *See generally* George Rzevski, Keynote Address to the Russian Academy of Science: Planning Under Conditions of Uncertainty (June 2007); Jules N. Pretty & Ian Scoones, *Institutionalizing Adaptive Planning and Local-Level Concerns: Looking to the Future*, *in* POWER AND PARTICIPATORY DEVELOPMENT: THEORY AND PRACTICE 157 (Nici Nelson & Susan Wright, eds., 1995); Helen Briassoulis, *Theoretical Orientations in Environmental Planning: An Inquiry into Alternative Approaches*, 13 ENVTL. MGMT. 381, 386–87 (1989); K. Matthias Weber, *Foresight and Adaptive Planning as Complementary Elements in Anticipatory Policy-making: A Conceptual and Methodological Approach*, *in* REFLEXIVE GOVERNANCE FOR SUSTAINABLE DEVELOPMENT 189 (Jan-Peter Voß et al. eds., 2006); Robert M. Klein, *Adaptive Planning: Not Your Great Grandfather's Schlieffen Plan*, 45 JOINT FORCES Q. 84, 86 (2007); Nina-Marie E. Lister & James J. Kay, *Celebrating Diversity: Adaptive Planning and Biodiversity Conservation*, *in* BIODIVERSITY IN CANADA: ECOLOGY, IDEAS, AND ACTION 189 (Stephen Bocking ed., 2000); Jack Ahern, *Theories, Methods and Strategies for Sustainable Landscape Planning*, *in* FROM LANDSCAPE RESEARCH TO LANDSCAPE PLANNING: ASPECTS OF INTEGRATION, EDUCATION, AND APPLICATION 119 (Bärbel Tress et al. eds., 2006); Paramjit S. Sachdeva, *Development Planning – An Adaptive Approach*, 17 LONG RANGE PLANNING 96 (1984).

[97] Arnold, *Adaptive Watershed Planning*, *supra* note 89, at 446-447.

> (4) conventional planning has centralized decision making, whereas adaptive planning occurs by decentralized self-organization;
>
> (5) conventional planning requires that the activities contemplated by the plan be executed within a specified period, whereas adaptive planning allows for executable activities to emerge from negotiations between constituent decision makers; and
>
> (6) conventional planning typically applies a single criterion to all activities, whereas adaptive planning allows for the balancing of or selection from among multiple decision criteria, against which to evaluate each activity.[98]

However, adaptive planning also contrasts with adaptive management. While both share many of the same features of flexibility, iterative processes, multiple options, and scientific and social learning through feedback loops, adaptive management tends to disregard the role of planning and goal-setting. In contrast, adaptive planning processes help to avoid standardless drift in management activities and address the interconnections between societal or governance goal-setting and day-to-day management actions.[99]

Adaptive planning is increasingly used in the United States and Canada for watershed planning and water supply planning in anticipation of climate change and its effects on watershed conditions and water supplies.[100] These examples of adaptive watershed planning for climate change show some promise for how environmental law can evolve, and new forms of adaptive processes can emerge to address the uncertainties created by adaptive cycles and complex inter-system dynamics. However, there is some reason to be concerned that feedback loops will be underutilized in actual practice, just as they are in adaptive management.[101] Moreover, adaptive

[98] Rzevski, *supra* note 96, at 4.
[99] Arnold, *Adaptive Watershed Planning*, *supra* note 89, at 421, 439.
[100] *Id.* at 471-78.
[101] *Id.* at 482-83.

plans might erroneously build flexibility into their content and planning processes by simply adopting vague goals and failing to making hard choices. Adaptive plans require concrete, rigorous standards so that decision makers and implementers can determine if goals are being met and if social-ecological resilience is improving.[102] Broad goals and flexible processes by themselves do little to ensure that people and organizations change behaviors that are harming the environment and/or human communities, particularly when it is not in their immediate self-interest to do so. Adaptive planning has to be integrated with some system of rules and rule enforcement, but not in such a way that rigidity in the legal system eliminates the adaptive capacity of the planning and management processes.

E. Adaptive Law

In a 2013 article in the *Environmental Law Reporter*[103] and a chapter of a 2014 book published by Columbia University Press, *Social-Ecological Resilience and Law*,[104] resilience scientist Lance Gunderson and I proposed a new resilience-based paradigm, which we call "adaptive law," to replace features of the legal system that are rigid, ignore interrelationships among social and ecological systems, emphasize front-end prescriptive rules, and generally are ill-equipped to adapt to rapid, unexpected change.[105] The adaptive law system has four features: "1) multiplicity of articulated goals; 2) polycentric, multimodal, and integrationist structure; 3) adaptive methods based on standards, flexibility, discretion, and regard for context; and 4) iterative legal-pluralist processes with feedback loops, learning and accountability."[106] The following overview summarizes the essential features of an adaptive law system:

> *"1. Adaptive Goals.* Adaptive law aims to achieve multiple co-existent forms of resilience, a concept known as

[102] *Id.* at 480-81, 484-86.

[103] *See* Arnold & Gunderson, *supra* note 6.

[104] Craig Anthony (Tony) Arnold & Lance H. Gunderson, *Adaptive Law*, *in* SOCIAL-ECOLOGICAL RESILIENCE AND LAW 317-364 (Ahjond S. Garmestani & Craig R. Allen, eds., 2014).

[105] Arnold & Gunderson, *supra* note 6, at 10429–31.

[106] *Id.* at 10428.

poly-resilience. In particular, a legal system that is adaptive to change serves to strengthen the adaptive capacity of both social systems, including institutions and communities, and ecological systems (or ecosystems). This is because the healthy functioning and adaptive capacity of various aspects of society – the economy, the political system, culture, and the like – and the healthy functioning and adaptive capacity of various ecosystems – such as watersheds, forests, and wetlands – are interdependent. If the legal system aims to advance the particular stability of just a single system, it risks harming all systems and contributing to the decline and collapse of both natural and human communities.

2. Adaptive Structure. An adaptive law system is polycentric, diversifying exposure to risk, creating redundancies that can absorb shock, and facilitating adaptive innovation by spreading power and authority among multiple centers. Power and authority are not concentrated in a single center, such as the federal government or the legislative branch, regardless of the temptation to overcome the perceived ineffectiveness of diffused power. A mistake or misjudgment by a single all-powerful entity, which is virtually inevitable given the cognitive limitations of humans and structural limitations of human organizations, is likely to create a cascade of failure and collapse throughout multiple, interconnected systems. In contrast, polycentric systems make it harder for failure and collapse to spread. An adaptive law system also uses multiple modes, methods, or instruments to address problems at multiple scales, instead of selecting a single "optimal" mode, method, or instrument that has the potential to fail or a single scale of governance that could be mismatched to the multiscalar features of complex problems. There are no panaceas in an adaptive governance system – no cookie-cutter one-size-fits-all magic-bullet solutions. However, an adaptive law system aims for loose integration among the multiple centers and scales of governance and the multiple methods or instruments that are

used, in contrast to the relatively fragmented characteristics of a maladaptive legal system.

3. Adaptive Methods. An adaptive law system facilitates social and ecological resilience through moderate evolution in rules, standards, processes, and structures as the system adapts to changing conditions. Change is neither resisted nor undertaken quickly and sweepingly. An adaptive law system uses context-regarding standards and flexible discretionary decision making, in contrast to legal abstractions, rigid rules, and excessive limits on action and authority. An adaptive law system also has a high tolerance for uncertainty, whereas the current legal system in the U.S. tends to demand certainty. Attempts to achieve certainty of outcomes, adhere to universally applicable rules, and prevent abuses of power are maladaptive when they fail to recognize that decision makers and actors in a system need flexibility, discretion, and authority to respond to new situations, adapt to changing conditions, and experiment with various possible solutions to public problems.

4. Adaptive Processes. An adaptive law system recognizes and embraces iterative processes among multiple participants, instead of linear decision-making and implementation processes by a single authority. An adaptive law system recognizes limits to human and organizational rationality and the effects of social and ecological forces on the ordering and management of human affairs, whereas a maladaptive law system presumes that all decision making is rational and that the law is central to the ordering and management of human affairs. However, there are many potential adverse effects from bounded human knowledge and rationality and the broad discretion of decision makers and actors in iterative processes that are not tightly constrained by law. An adaptive law system limits these effects by: a) mandating feedback loops by which the effects of decisions and actions are monitored and evaluated, lessons learned, and decisions or actions altered on the basis of

> lessons learned, and b) utilizing accountability mechanisms for the conservation of natural, human, social, political, and economic capital so that the functions of the basic infrastructure that supports nature and society are not impaired." [107]

Improved adaptive capacity within the legal system is particularly needed in the field of environmental law. However, law cannot mandate social-ecological resilience. Law is not an autonomous system apart from governance institutions in society generally, nor is it an all-controlling center of power in a tightly hierarchical system. We need not only adaptive legal systems specifically but also adaptive governance systems generally. The legal system can either facilitate or inhibit adaptive governance decisions and systems that can strengthen the resilience of interconnected social-ecological systems.

F. Adaptive Governance

Environmental law is a framework in which human governance of human and natural environments – linked social and ecological systems – occurs. An adaptive and resilience-building environmental law system is one that creates the boundaries and space in which adaptive governance emerges. Chaffin et al. have studied a growing literature on adaptive governance from many different disciplines and have developed a synthesized definition of adaptive governance: "a range of interactions between actors, networks, organizations, and institutions emerging in pursuit of a desired state for social-ecological systems."[108] They draw on several other prominent definitions of adaptive governance. These include: "managing diverse human-environmental interactions in the face of extreme uncertainty," by Dietz et al.;[109] "the process of creating adaptability and transformability in social-ecological systems and the evolution of rules that influence resilience

[107] This selection appears in Arnold, *Adaptive Water Law*, *supra* note 57, at 1066-1069 (citing Arnold & Gunderson, *supra* note 6, at 10428–42).

[108] Brian Chaffin et al., *A Decade of Adaptive Governance Scholarship: Synthesis and Future Directions*, 19(3) *Ecology and Society* 56 (2014).

[109] *Id.* at Table 1 (quoting Dietz et al. (2003)).

during self-organization," by Walker et al.;[110] and "the evolution of new governance institutions capable of generating long-term sustainable policy solutions to wicked problems through coordinated efforts involving previously independent systems of users, knowledge, authorities, and organized interests," by Scholz and Stiftel.[111]

These scholarly definitions are quite broad and general, aiming to be so inclusive that they end up being vague and confusing to governance participants. Nelson et al. give a somewhat clearer picture of what adaptive governance means:

> Successful adaptation in effect entails steering processes of change through institutions, in their broadest sense. For adaptation to be successful, institutions clearly need to endure and be persistent throughout the process of adjustment and change. But at the same time, they need themselves to cope with changing conditions. . . . [T]he strong normative message from resilience research is that shared rights and responsibilities for resource management (often known as comanagement) and decentralization are best suited to promoting resilience. . . . The 'pinnacle' of comanagement is the idea that governance systems themselves can be adaptable through internal learning – both institutional arrangements and ecological knowledge should be 'tested and revised in a dynamic, ongoing, self-organized process of trial and error' facilitated through high levels of autonomy and decentralization.[112]

Adaptive governance might be better understood through its features. Once again, many different scholars have many different lists of features of an adaptive governance system, but they tend to converge around common themes. According to Chaffin et al., adaptive governance is scaled to the social or ecological systems influencing the problems that it seeks to address;

[110] *Id.* (quoting Walker et al. (2004)).
[111] *Id.* (quoting Scholz and Stiftel (2005)).
[112] Nelson et al., *supra* note 69, at 409.

is polycentric (multiple centers of power), redundant in function, diverse, and connected across scales through networks; uses adaptive management methods; and emerges from self-organizing activity.[113] Scholz and Stiftel emphasize: 1) getting representation of interests or stakeholders that there is sufficient to have buy-in to governance decisions but not unduly burdensome on governance structures and processes; 2) decision processes that are characterized by flexibility, legitimacy, transparency, expertise, trust, and accountability; 3) scientific learning; 4) public learning; and 5) policy decisions and implementation that respond well to the problem as measured by efficiency, equity, an appropriate trade-off of adaptability with stability, and conservation of natural resources.[114] Huitema et al. argue that adaptive institutions are characterized by polycentric governance, public participation, experimentation, and a bioregional perspective.[115] I led an interdisciplinary team of scholars in a study of the Anacostia River Basin that gave particular attention to the dynamics of and capacity for institutional change in relationship to social system change and ecosystem change.[116] In our view, some of the adaptive characteristics of new watershed governance systems in the Anacostia River Basin are: 1) scaling of governance to multiple ecological or ecosystem scales (multiscalar and scaled to the problems to be addressed); 2) polycentric and modular governance structures; 3) highly participatory decision making and implementation processes; 4) use of multiple methods and instruments (multi-modality); 5) diversity in innovation and experimentation; 6) redundancy of efforts and resources; 7) loose but active networks across scales and nodes of governance activity; 8) use of conflict, litigation, and legal processes to develop cooperative problem solving; 9) iterative processes; and 10) feedback loops that increase scientific and social learning.[117] We also believe that adaptive governance is an

[113] Chaffin et al, *supra* note 108.

[114] John T. Scholz & Bruce Stiftel, *The Challenges of Adaptive Governance*, *in* ADAPTIVE GOVERNANCE AND WATER CONFLICT: NEW INSTITUTIONS FOR COLLABORATIVE PLANNING 1, 5-10 (John T. Scholz and Bruce Stiftel, eds., 2005).

[115] Dave Huitema et al., *Adaptive Water Governance: Assessing the Institutional Prescriptions of Adaptive (Co-) Management from a Governance Perspective and Defining a Research Agenda*, 14(1) ECOLOGY & SOCIETY 26 (2009).

[116] Arnold et al., *supra* note 24.

[117] *Id.*

emergent phenomenon that is shaped, supported, or deterred by features of the legal system.[118]

V. THE EMERGENCE OF ADAPTIVE ENVIRONMENTAL LAW FOR SOCIAL-ECOLOGICAL RESILIENCE

As environmental law evolves, new elements and frameworks emerge to help communities and ecosystems navigate changes, disturbances, and instabilities. Fourth-generation environmental law developments include: watershed governance; "wet growth" policies and regulations that link land use, water supply, and water quality; local climate action plans (both mitigation and adaptation), particularly when they lead to changes in regulations, programs, or decision making; and the increasing use of federal, state, and local authority to conserve ecosystem services in cities and increase the use of green infrastructure to manage or mitigate environmental stressors.[119] This article looks at watershed governance as an example of emergent fourth-generation environmental law to assess its capacity to improve adaptation and resilience in both ecosystems and human communities.

Governance institutions, systems, and processes have arisen throughout the United States centered around watersheds.[120] Watersheds are areas of land that drain to common bodies of water, such as rivers, streams,

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[118] *Id.*

[119] Arnold, *Fourth-Generation Environmental Law*, *supra* note 4, at 837-66; Alexandra Dapolito Dunn, *Siting Green Infrastructure: Legal and Policy Solutions to Alleviate Urban Poverty and Promote Healthy Communities*, 37 B.C. ENVTL. AFFAIRS L. REV. 41 (2010); Keith H. Hirokawa, *Sustaining Ecosystem Services through Local Environmental Law*, 28 PACE ENVTL. L. REV. 760 (2011); Keith H. Hirokawa, *Sustainability and the Urban Forest: An Ecosystem Services Perspective*, 51 NATURAL RESOURCES J. 233 (2012); Lynn Scarlet & James Boyd, *Ecosystem Services and Resource Management: Institutional Issues, Challenges, and Opportunities in the Public Sector*, ECOLOGICAL ECON. (2013). For a new assessment of the state of the urban ecosystem services literature, particularly as it relates to law, planning, and policy, see James Salzman et al., *The Most Important Current Research Questions in Urban Ecosystem Services*, forthcoming in the DUKE ENVTL. L. & POL'Y FORUM.

[120] Arnold, *Framing Watersheds*, *supra* note 26, at 271, 278-80.

and lakes.[121] Watershed governance institutions have emerged out of the inadequacies and dysfunctional fragmentation of existing laws and governance systems, the appropriateness of the watershed scale for addressing linked land-water-environment problems, disturbances created by the legal system (e.g., litigation, the threat of governance by inflexible regulation, statutory mandates of and/or funding for watershed planning), disturbances created by ecological or social changes (e.g., drought, flood, population and land-development growth, invasive species), the polycentricity and diversity of watershed governance, and self-organizing collaborative behaviors around watersheds.[122]

Adaptive watershed governance has evolved from existing legal frameworks. For example, the State of Washington has legislation that mandates watershed planning around state-designated water resource inventory areas ("WRIAs"). However, many WRIA watershed planning processes have gone far beyond the legislative mandate to address optional elements in integrated ways, to consider the uncertain impacts of climate change on watersheds, water supplies, aquatic species, and water quality, to develop local land-use regulations that would advance the plan's goals, and to continue to function after planning periods and state funding have ended.[123] The review and renewal of the 1964 Columbia River Treaty between the United States and Canada, as well as the protection of aquatic species in the Columbia River by the Endangered Species Act, are creating opportunities for adaptive Columbia River basin governance to emerge.[124] Water-quality litigation and regulation concerning the Fenholloway River in Florida led to a collaborative initiative to reevaluate environmental standards for the waterway, followed by a watershed restoration project.[125] The City of Philadalphia is aiming to come into compliance with the Clean Water Act by

[121] *Id.* at 271.

[122] *Id.* at 271, 273-81; Arnold, *Adaptive Water Law*, *supra* note 57, at 1082.

[123] Arnold, *Framing Watersheds*, *supra* note 26, at 295-96.

[124] *See generally* Barbara Cosens & Mark Williams, *Resilience and Water Governance: Adaptive Governance in the Columbia River Basin*, 17(4) ECOL. & SOC'Y 3 (2012).

[125] Simon A. Andrew, *Fenholloway River Evaluation Initiative: Collaborative Problem-Solving Within the Permit System*, *in* ADAPTIVE GOVERNANCE AND WATER CONFLICT, *supra* note 114, at 40-51; *see generally* FENHOLLOWAY RIVER ENVTL. RESTORATION PROJECT, http://www.fenholloway.com/ (last visited Dec. 4, 2014).

developing and implementing a watershed-based plan to make substantial use of green infrastructure.[126] Likewise, the State of Missouri is facilitating the use of local watershed planning as a means of shared reductions in runoff and pollution.[127] A growing number of cities are using or developing legal authority to adaptively manage watershed lands and features, often outside their jurisdictions, in order to protect their water supplies; these cities include New York City, NY,[128] Wichita, KS,[129] Santa Fe, NM,[130] and Portland, OR.[131]

The adaptive features of fourth-generation environmental law can be seen in three different kinds of emergent watershed governance systems. The first is in the Anacostia River basin in Washington, DC, and Maryland. The second is in the Blackfoot River basin in Montana. The third is in the Santa Ana River basin in California.

Watershed governance in the Anacostia River consists of a basin-wide restoration plan, restoration plans for the many sub-watersheds, a water-quality and remediation plan, a riverfront development plan, several multi-stakeholder or multi-agency partnerships across jurisdictions, numerous programs of federal, state, or local agencies aimed at watershed conservation and restoration, and 20-30 citizen groups organized around conservation of the watershed or one of its sub-watersheds.[132] Stormwater management

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[126] *See Green City, Clean Waters*, PHILADELPHIA WATER DEPARTMENT, http://www.phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_control_plan (last visited Mar. 01, 2014); Institute for Sustainable Communities Climate Leadership Academy, *Promising Practices in Adaptive Urban Water Management, Version 2.0* 18-24 (2013).

[127] *Our Missouri Waters*, MISSOURI DEPARTMENT NAT. RESOURCES., https://www.dnr.mo.gov/omwi.htm (last visited Mar. 01, 2014).

[128] Barton H. Thompson, Jr., *Markets for Nature*, 25 WM. & MARY ENVTL. L. & POL'Y REV. 261, 298-99 (2000).

[129] REED WATSON & BRANDON SCARBOROUGH, PROP. & ENVTL. RESEARCH CTR., CHENEY LAKE WATERSHED: FARMING WATER QUALITY IN KANSAS (2010).

[130] Keith H. Hirokawa, *Driving Local Governments to Watershed Governance*, 42 ENVTL. L. 157, 180-82 (2012)

[131] THE TRUST FOR PUBLIC LAND AND THE AMERICAN WATERWORKS ASSOCIATION, THE SOURCE PROTECTION HANDBOOK: USING LAND CONSERVATION TO PROTECT DRINKING WATER SUPPLIES 21-22, 33-35 (2004).

[132] Arnold et al, *supra* note 24.

regulations, runoff management incentives, land-use regulations, and acquisition of conservation interests in land are among the new watershed-focused legal developments that have emerged.[133] A major focus of new policies and laws is on the increased use of green infrastructure (e.g., green roofs, rain gardens, bioswales, wetlands, and trees) to prevent or manage stormwater runoff, as well as restoration of important watershed features, such as wetlands.[134] Watershed governance in the Anacostia emerged, because land development and pollution generation vastly increased harmful stormwater runoff and pollution levels in the river and its tributaries, as well as altering water levels, flows, wetlands, forests, riparian lands, and the like.[135] Consent decrees in lawsuits over combined sewer overflows (CSOs), the setting of Total Maximum Daily Loads (TMDLs) for the Anacostia and its streams, and requirements that localities obtain Municipal Separate Storm Sewer System (MS4) discharge permits, all of which arose under the Clean Water Act, pushed government agencies, stakeholders, and the public to work together to address overall watershed conditions.[136] Attention to the effects of racial and class injustices, particularly in low-income African American neighborhoods in and near Washington, DC, is also a part of watershed governance in the Anacostia.[137]

Watershed governance institutions in the Anacostia aim to bring back the watershed from the brink of the total or near-total hydrological and biological collapse that would be likely to occur if impervious cover and stormwater runoff were to continue to increase unabated. They also aim to strengthen human communities and connect the resilience and vitality of human communities with the resilience and vitality of the watershed as an ecosystem. These institutions are polycentric, existing at many scales of governance and at multiple ecological or hydrological scales, but there are active, robust networks among the various participants and initiatives. They are multimodal in that they employ a broad range of strategies, instruments, and tools. Public participation is high, and many citizen groups became

[133] *Id.*
[134] *Id.*
[135] *Id.*
[136] *Id.*
[137] *Id.*

increasingly engaged with the watershed. Plans, restoration projects, and green infrastructure strategies are relatively flexible, and subject to adjustment as changing conditions warrant.

The Blackfoot Challenge – a multi-stakeholder watershed governance framework for Montana's Blackfoot River watershed, composed of over 100 ranchers and farmers and twenty-seven federal and state government agencies and nongovernmental organizations – is also emergent, evolving, and adaptive.[138] The framework emerged out of the stakeholders' desire to address watershed problems in ways that are more flexible, innovative, and participatory than traditional regulatory regimes, such as the Endangered Species Act (ESA).[139] Nonetheless, the U.S. Fish and Wildlife Service and Trout Unlimited – entities that normally use the ESA and other regulatory regimes for environmental conservation – were instrumental in helping to start the Blackfoot Challenge.[140] This self-governing watershed partnership has evolved in the types of issues that it addresses and the methods of governance that it uses: from a noxious weed control program using education and technical assistance, to the development of best management practices for protection of waters and riparian areas from cattle, to proactive bear and wolf management, to the development of a land conservation easement program to protect both the ecological and cultural conditions of the rural Blackfoot Valley from land development, to creation of a Drought Response Plan that calls for shared reductions in usage during drought regardless of the participants' priority of water rights.[141] Through these iterations of watershed governance in the Blackfoot Valley, the participants in the Blackfoot Challenge have attempted to strengthen both the ecological resilience of the watershed and the social-cultural resilience of the local ranching and farming community to many disturbances like climate change, drought, invasive species, livestock predators, and land development. They have created flexible rules and policies that have circumvented the rigidity of laws like the prior appropriation doctrine or the ESA, yet have led to

[138] Arnold, *Adaptive Water Law*, *supra* note 57, at 1085-86.
[139] *Id.*
[140] *Id.*
[141] *Id.*

improved conditions in water quality, water flows, aquatic species health, and human-wildlife interactions.[142]

The Santa Ana Watershed Project Authority ("SAWPA") was created in 1968 by government agencies within California's Santa Ana Watershed, first as a planning agency and then as a water-quality and watershed protection agency.[143] It is a regional planning and coordinating entity with a professional staff. It works with local governments, other government agencies, and stakeholders within the watershed to plan watershed conservation, secure funding and legal reforms, and coordinate strategies and actions to protect the watershed.[144] Its role has changed and grown over time as the threats to and future uncertainties of the watershed have grown. In 2010, SAWPA developed a bold, resilience-seeking plan for the watershed entitled the One Water, One Watershed Plan or the Santa Ana Integrated Watershed Plan.[145] The plan contained numerous goals and strategies. In 2014, SAWPA adopted the One Water, One Watershed Plan 2.0 ("OWOW 2.0"), which reiterates the original plan's foundational goals but also strengthens the structures and processes for integrated and collaborative watershed management. OWOW 2.0 adds specific performance standards or targets to achieve by 2035, and monitoring, assessment, and plan revision processes; together, these standards and processes create the feedback loops needed for adaptive planning and management.[146]

The Santa Ana plans aim to enhance both the social and ecological resilience of the watershed in several ways (i.e., polyresilience), seeking "a sustainable Watershed that is drought-proofed, salt-balanced, and supports

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[142] *Id.*

[143] *Meet Us: SAWPA General Information*, SANTA ANA WATERSHED PROJECT AUTHORITY, http://www.sawpa.org/meet-us/.

[144] *About Us*, SANTA ANA WATERSHED PROJECT AUTHORITY, http://www.sawpa.org/meet-us/details/.

[145] SANTA ANA WATERSHED PROJECT AUTHORITY, ONE WATER, ONE WATERSHED: 2010 SANTA ANA INTEGRATED WATERSHED PLAN (2010), *available at* http://www.sawpa.org/owow-1-0-2/.

[146] SANTA ANA WATERSHED PROJECT AUTHORITY, ONE WATER, ONE WATERSHED 2.0 PLAN, EXECUTIVE SUMMARY 5–8 (2014), *available at* http://www.sawpa.org/wp-content/uploads/2012/05/Executive-Summary-Final.pdf

economic and environmental viability."[147] For example, they propose creating additional storage for recycled water and stormwater runoff, which will not only buffer public water supplies from shocks of drought and variations over time but will also reduce demands on instream flows and groundwater, while helping to maintain the structures and functions of aquifers and reducing erosion of river banks and pollution of surface waters.[148] The plans urge a careful reconsideration of flood planning based on 100-year flood probabilities created from historic data that may no longer accurately predict future flood intensity and scope.[149] The plans call for linking green infrastructure, native landscaping, low-impact development that reduces impervious surfaces, and water-efficient landscaping and irrigation in order to reduce stormwater runoff and conserve water for both environmental-impact and human-impact reasons.[150] Perhaps most impressively, the plans expressly contemplate climate change as creating both uncertain and unstable future conditions that will affect the watershed. In the plans, SAWPA applies several quantitatively different climate-change models to predict various plausible future scenarios of temperatures, precipitation, and sea level rise that are then used to develop strategies that would work well under any of these possible futures to address many stressors on the watershed: increased evaporation and transpiration; increased water demands; longer, hotter, and more frequent heat waves; increased wildfire risks; higher peak energy demands; diminished air quality; changes in water temperatures; decreased water quality and related biotic stresses; decreased precipitation on supplies of imported water; increased flood risks; decreased groundwater replenishment; and risks to the reliability of local water supplies.[151] The plans consider link climate change analyses with other sources of uncertainty and change, such as Colorado River drought conditions, San Joaquin Delta vulnerability, and population growth and development.[152]

[147] SAWPA, 2010 PLAN, *supra* note 145, at ch. 1.
[148] *Id.*, at ch. 5.
[149] *Id.*
[150] *Id*.
[151] *Id.* at ch. 5 & 9.
[152] *Id.* at ch. 1.

Watershed governance in the Santa Ana River watershed integrates different fields of law and governance, including water supply, water quality, surface water, groundwater, land-use planning and regulation, and energy, among others. However, it does so by utilizing a polycentric but linked network of local government agencies, specialized state and special-district agencies, interested stakeholders, and the public in highly participatory planning processes that connect societal goal-setting, legal authority and tools, and scientific study and management with one another. It is multimodal in its use of many tools like water conservation measures, changes in land-use planning and regulation, conjunctive management of surface water and groundwater with increased storage of water in the basin for future needs, public education programs, greater use of rainfall as a basin-wide water source, and increased use of best management practices (BMPs) to control and reduce polluted stormwater runoff.[153] The plan adopts conditional and flexible standards for adaptive implementation of the plan, instead of rigid rules, and uses new information to develop new standards, such as new pathogen indicators and new residual chlorine standards.[154] The changes in SAWPA's mission and watershed governance activities, including the development of a 2.0 Plan just four years after the initial plan, based on identified needs to strengthen the plan and make it more adaptive indicate the evolving nature of watershed governance in the Santa Ana River watershed. This example of fourth-generation environmental law is promising, suggesting that the resilience and adaptive capacity of watersheds as linked social-ecological systems could be increased, even as threats of climate change and other disturbances loom.

VI. POTENTIAL FOR DISAPPOINTMENT AND REASONS TO HOPE

Despite its promise, fourth-generation environmental law may prove to be quite disappointing for several reasons. First, it might simply be an additive phenomenon and not truly transformational. This would mean that it would help to improve systemic resilience and adaptive capacity in incremental or small-scale ways but not be adequate to facilitate the

[153] ID. at ch. 5 & 9.
[154] ID. at ch. 5.

navigation of communities and ecosystems through changes, disturbances, and instabilities.

Second, fourth-generation environmental law might under-protect both ecosystems and human communities because it lacks sufficiently clear, mandatory standards for decisions and actions. Flexibility and adaptive capacity without any rules, standards, or accountability mechanisms to constrain this flexibility could facilitate behaviors and policies that favor uncontrolled exploitation of and harm to the environment for short-term gain.

Third, complexity is complex. Fourth-generation environmental law might contemplate the complexity of interconnected social-ecological systems, but this acknowledgement is not adequate by itself to build resilient institutions and produce adaptive responses to this complexity. The environmental problems that American society faces now, and will face in the future, will be difficult to solve or manage, regardless of which generation of environmental law is being used.

Finally, one of the most persistent and frustrating limitations of adaptive management, planning, law, and governance is the failure to translate the theory of feedback loops into the reality of feedback loops. In most examples there is very little creation of formal, mandatory processes of monitoring, assessment, learning, and adaptation of decisions based on lessons learned from monitoring and assessment. This is just another type of standardless flexibility: governance experimentation without rigorous methods and processes for assessing the outcomes of the experiments and making changes to governance decisions based on those outcomes.

Each of these reasons why fourth-generation environmental law might be disappointing and inadequate has a corresponding reason why fourth-generation environmental law is promising and could be helpful. First, environmental law and governance are evolutionary by nature. What might appear to be merely incremental and small-scaled changes in systemic capacity could turn out to be significant, even transformational, over time.

Second, fourth-generation environmental law's use of resilience science allows for the development and application of rigorous standards that are better matched to social-ecological complexity and dynamism than rigid

rules and standards aiming to sustain or preserve environments in their existing state or restore them exactly to some pre-disturbance state.[155] For example, standards can be set on the basis of major drivers of change in interconnected social-ecological systems.[156] Pre-caution to avoid approaching major thresholds of irreversible change in social or ecological systems is one such standard.[157] Integration of social-system or human-community resilience, institutional resilience, and ecosystem resilience, sometimes referred to as poly-resilience, is another such standard.[158]

Third, social-ecological complexity is a reality that cannot be "solved" or simplified by social engineering. Thus, environmental-law frameworks and features that acknowledge and are built around social-ecological complexity are more promising than those that either ignore or challenge this reality. Fourth-generation environmental law is an attempt to deal with social-ecological complexity.

Finally, fourth-generation environmental law is characterized by informal and emergent feedback loops through iterative governance processes and community learning.[159] Watershed governance networks are

[155] The concept of resilience is increasingly replacing the concept of sustainability as a desired policy goal and way of evaluating collective behaviors shaping interdependent environmental conditions and social conditions. Robin Kundis Craig & Melinda Harm Benson, *Replacing Sustainability*, 46 AKRON L. REV. 841, 862 (2013).

[156] For the use of resilience assessments to identify major drivers of change that can be used in guiding governance and management actions, see generally RESILIENCE ALLIANCE, ASSESSING RESILIENCE IN SOCIAL-ECOLOGICAL SYSTEMS: WORKBOOK FOR SCIENTISTS, VERSION 1.1 (2007) and RESILIENCE ALLIANCE, ASSESSING RESILIENCE IN SOCIAL-ECOLOGICAL SYSTEMS: WORKBOOK FOR PRACTITIONERS, VERSION 2.0 (2010).

[157] This is the primary point, with several guiding principles or standards for environmental law, that Robin Kundis Craig makes in Craig, *Stationarity is Dead*, *supra* note 55.

[158] Arnold & Gunderson, *supra* note 6, at 10428-32.

[159] *See generally* Scholz & Stiftel, *supra* note 114; David Feldman & Helen Ingram, *Making Science Useful to Decision Makers: Climate Forecasts, Water Management, and Knowledge Networks*, 1 WEATHER, CLIMATE, & SOC'Y 9 (2009). For two excellent works discussing the role of politics in the evolving innovation and public learning processes of watershed governance and urban runoff management, see EDELLA SCHLAGER & WILLIAM BLOMQUIST, EMBRACING WATERSHED POLITICS (2008); ANDREW KARVONEN, POLITICS OF URBAN RUNOFF: NATURE, TECHNOLOGY, AND THE SUSTAINABLE CITY (2011).

learning from the implementation of plans and strategies and frequently adjusting their strategies, their actions, and even the issues that they are addressing, in response to lessons learned and changed conditions.[160] In a more specific example, early experiences with rigid consent decrees for combined-sewer overflows (CSOs) have led to more flexible outcome-oriented consent decrees that give localities more flexibility to use multiple methods and to innovate with methods for reducing CSOs.[161]

VII. HOPE AS A RESILIENT AND ADAPTIVE STRATEGY

The four generations of U.S. environmental law offer us disappointment in their limitations and failures, optimism that a new generation will overcome these limitations and failures, and finally, the recognition that the new generation has its own inherent limitations and potential to fail. Long-time environmental law scholar Denis Binder has recently reflected on the first forty decades of post-Earth Day environmental law in the United States, and he offers a mix of critique, caution, praise, and hope.[162]

Is it even appropriate to be hopeful about U.S. environmental law, though? After all, there seems little reason to hope when we think of the ecological and human harms from Hurricane Katrina's interplay with altered landscapes and waterscapes of South Louisiana,[163] the environmental and societal impacts of water shortages and wildfires in the western United States,[164] and the half a million people in Toledo without safe drinking water from toxins caused by algae blooms in Lake Erie.[165] These are just a few

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[160] Arnold, *Framing Watersheds*, *supra* note 26, at 294-301.

[161] *See, e.g.*, Arnold et al., *supra* note 24.

[162] *See generally* Denis Binder, *Perspectives on Forty Years of Environmental Law*, 3 J. ENERGY & ENVTL. L. 143 (2012); Denis Binder, *Looking Back to the Future: The Curmudgeon's Guide to the Future of Environmental Law*, 46 AKRON L. REV. 993 (2013).

[163] *See supra* note 44.

[164] Dennis Dimick, *Drought, Fire, and the New Normal in the American West*, NATIONAL GEOGRAPHIC (May 16, 2014) , http://news.nationalgeographic.com/news/2014/05/140516-drought-wildfire-insects-southwest-connect-dots/.

[165] George Tanber, *Toxin leaves 500,000 in northwest Ohio without drinking water*, REUTERS and YAHOO! NEWS (Aug. 2, 2014, 7:35), http://news.yahoo.com/toledo-ohio-

problems that have not been prevented or solved by environmental law. As Jim Salzman and J.B. Ruhl have pointed out, the social-ecological problems that environmental law is now asked to address are massive, complex, and daunting.[166]

However, a cautiously hopeful perspective on environmental law is a strategy for building social, institutional, and human resilience and capacity to adapt to uncertainty, instability, and change. First, hope is preferable to two other positive perspectives – spurious certitude and optimistic complacency – and to three negative perspectives – alarmism, pervasive or continual criticism, and pessimistic complacency. Hope is not the same as unwarranted faith either in existing institutions, behaviors, and technologies to sustain our environments and communities or in our capacity to design the right institutions, stimulate the right behaviors, and create the right technologies that will solve environmental and societal problems. Excessive optimism is not a particularly resilient strategy in the long-run. On the other hand, neither institutions nor communities improve their adaptive capacity through shrill warnings about imminent and overwhelming catastrophe, critiques of all existing or proposed legal regimes or courses of action, or passive resignation about social and environmental crises. Excessive pessimism is also not a strategy for resilience.

Second, research on the psychology of hope suggests that it is essential to human resilience and institutional adaptation under conditions of social-ecological complexity and systemic instabilities. According to psychologists, hope is "a positive motivational state that is based on an interactively derived sense of successful (a) agency (goal-directed energy) and (b) pathways (planning to meet goals)."[167] In other words, hope is both

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warns-customers-not-drink-tap-water-185050966.html.

[166] *See generally* Ruhl & Salzman, *supra* note 9.

[167] Charles R. Snyder, *Hypothesis: There Is Hope*, *in* HANDBOOK OF HOPE THEORY, MEASURES AND APPLICATIONS 3, 8 (Charles R. Snyder, ed. 2000). Snyder is a leader theorist and empirical researcher of the phenomenon of hope. *See* CHARLES R. SNYDER, THE PSYCHOLOGY OF HOPE: YOU CAN GET THERE FROM HERE (1994); Charles R. Snyder et al., *The Will and the Ways: Development and Validation of an Individual-Differences Measure of Hope*, 60(4) J. PERSONALITY & SOC. PSYCH. 570 (1991); Charles R. Snyder, *Conceptualizing, Measuring, and Nurturing Hope*, 73 J. COUNSELING & DEV. 355 (1995);

the will to achieve goals (agency) and a set of different ways to achieve those goals (pathways).[168] Hope is a scientifically observable and measurable trait of individuals, and it is also a state that people can develop or achieve.[169] Hope is not naïve optimism based in emotion. In fact, research shows that hope is based first in cognition that then triggers emotion and is a separate phenomenon from optimism (an expectation of a positive future) and from self-efficacy (a belief that one can master a domain).[170] It is a dynamic system of cognition and motivation that promotes learning goals, which are adaptive to the context and changing conditions, as well as involve self-monitoring of progress and adjustments in strategies based on outcomes (feedback loops).[171] Hope can be stimulated or developed. Research shows that when people are told to think hopefully about a situation – a type of hope known as situational hope, in contrast to dispositional hope – they are able to generate many more ideas about how to achieve their goals, a phenomenon known as divergent thinking.[172] High levels of hope, as measured by the well-tested Hope Scale developed by Charles Snyder and fellow researchers, are positively and often strongly correlated to positive outcomes: goals are more likely to be achieved when people have the will to achieve them and can identify multiple ways to achieve them.[173] People who are hopeful overcome barriers to achieving their goals and adapt their strategies and actions as they encounter changing conditions.

Hope is important to environmental protection and conservation. Conservation biologists have begun to recognize that scientists need to

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Charles R. Snyder et al., *Development and Validation of the State Hope Scale*, 70(2) J. PERSONALITY & SOC. PSYCH. 321 (1996); Charles R. Snyder et al., *The Development and Validation of the Children's Hope Scale*, 22(3) J. PEDIATRIC PSYCH. 399 (1997); Charles R. Snyder et al., *Preferences of High- and Low-Hope People for Self Referential Feedback*, 12 COGNITION & EMOTION 807 (1998); Charles R. Snyder et al., *Hope and Academic Success in College*, 94(4) J. EDUC. PSYCH. 820 (2002).

[168] Scott Berry Kaufman, *The Will and Ways of Hope*, PSYCHOLOGY TODAY (Dec. 26, 2011).

[169] *Id.*; Katie Hanson, *What Is Hope and How Can We Measure It?*, POSITIVE PSYCHOLOGY.

[170] Kaufman, *supra* note 168.

[171] *Id.*

[172] *Id.*

[173] *Id.*; Hanson, *supra* note 169.

cultivate a culture of hope among themselves if they are to continue to recruit bright people to become conservation scientists, and if they are to use science to mobilize the public to engage in conservation action.[174] They recognize that realism about troubling environmental problems, such as species' extinction, habitat destruction, or the impacts of climate change, is necessary, but that it must be balanced with a practical belief that action to protect species, habitats, and ecosystems will actually make a difference.[175] Psychologists observe that cultivating hope and high expectations of success help to stimulate pro-environmental behaviors or behavioral change by individuals in society and that people's environmentalist identities or ethics are often developed by their participation in high-efficacy environmental action.[176]

Hope is also critical to collective environmental action, not just individual behavior. Political economists observe that hope sustains both non-profit organizations and coalitions of policy leaders, enabling continued leader and member engagement in pursuit of policy goals in the face of disappointments and setbacks.[177] In other words, environmental organizations and policymakers need hope – not only the energy or will to

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[174] *See generally* Ronald R. Swaisgood & James K. Sheppard, *The Culture of Conservation Biologists: Show Me the Hope!*, 60(8) BIOSCIENCE 626 (2010); Ronald R. Swaisgood & James K. Sheppard, *Hope Springs Eternal: Biodiversity Conservation Requires That We See the Glass as Half Full*, 61(6) BIOSCIENCE 427 (2011); Jeremy Hance, *Why Conservationists Need a Little Hope: Saving Themselves from Becoming the Most Depressing Scientists on the Planet*, MONGABAY.COM, Aug. 19, 2014. Similar call for hope has been issued to environmental sociologists and environmental philosophers. *See* Michelle A. M. Lueck, *Hope for a Cause as Cause for Hope: The Need for Hope in Environmental Sociology*, 38 AM. SOC. 250 (2007); Lisa Kretz, *Hope in Environmental Philosophy*, 26 J. AGRIC. ENVT'L. ETHICS 925 (2013).

[175] Swaisgood & Sheppard, *The Culture of Conservation Biologists*, *supra* note 174, at 627-28; Swaisgood & Sheppard, *Hope Springs Eternal*, *supra* note 174, at 427.

[176] Swaisgood & Sheppard, *The Culture of Conservation Biologists*, *supra* note 174, at 629 (citing, *inter alia*, SUSAN CLAYTON & GENE MYERS, CONSERVATION PSYCHOLOGY: UNDERSTANDING AND PROMOTING HUMAN CARE FOR NATURE (2009)).

[177] Jan-Erik Lane & Joe Wallis, *Non-profit Organizations in Public Policy Implementation*, 1(7) J. PUB. ADMIN. & POL'Y RESEARCH 141, 142-44 (2009)l Joe Wallis & Brian Dollery, *Policy Leadership Styles and the Process of Paradigmatic Policy Change: Three Propositions*, UNIVERSITY OF OTAGO ECONOMIC DISCUSSION PAPERS NO. 0203, ISSN 0111-1760 (March 2002), at 5-6.

seek their goals but also the pursuit of multiple ways of achieving their goals – in order to overcome barriers to environmental policies. Likewise, public opinion and support for environmental policies and laws depend on a belief that these policies or laws will make a difference. A belief that environmental problems are inescapably dire or pose unknowable probabilities of catastrophe results in feelings of helplessness, which in turn lead to inaction or lack of support for collective efforts to address the problems.[178] More generally, social scientists link public or collective hope to effective governance.[179] On one hand, they caution that public hope (as opposed to individual hope) can be dangerous if it is disconnected from the resilience of social institutions, leads to unrealistic optimism and irrational action, or is used to manipulate the public in order to advance special interests or agendas.[180] More significantly, they argue that when hope is balanced with precaution, rational analysis, checks on unconstrained power, and inclusion, it produces more collective action, more cooperation between the public and the state, improved planning for public goals, increased pro-social civic and human values, more generation of policy alternatives, and greater capacity to address and liberate people and groups from social and structural inequities.[181]

Fourth-generation environmental law is itself an exercise in hope: an effort to build the adaptive capacity of institutions and society in order to, in

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[178] Swaisgood & Sheppard, *The Culture of Conservation Biologists*, *supra* note 174, at 627.

[179] *See generally* Symposium, *Hope, Power, and Governance*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 186 (2004).

[180] Peter Drahos, *Trading in Hope*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 18 (2004).

[181] Valerie Braithwaite, *Collective Hope*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 6 (2004); Drahos, *supra* note 180; Sasha Courville & Nicola Piper, *Harnessing Hope through NGO Activism*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 29 (2004); Clifford Shearing & Michael Kempa, *A Museum of Hope: The Story of Robben Island*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 62 (2004); John Braithwaite, *Emancipation and Hope*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 79 (2004); Victoria McGeer, *The Art of Good Hope*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 100 (2004); Valerie Braithwaite, *The Hope Process and Social Inclusion*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 128 (2004); Philip Pettit, *Hope and Its Place in Mind*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 152 (2004); John Cartwright, *From Aquinas to Zwelethemba: A Brief History of Hope*, 592 ANNALS AM. ACAD. POL. & SOC. SCI. 166 (2004).

turn, strengthen the resilience of ecosystems on which humans and society depend. Fourth-generation environmental law is about the emergence of new collective energies – such as watershed governance and urban green-infrastructure policies – to achieve the goals of resilient ecosystems and resilient human communities. This is the agency element of hope. Fourth-generation environmental law is also about the use of multiple methods, instruments, and even institutional arrangements – known as multimodality – in systemic ways to pursue these goals of social-ecological resilience. This multimodal approach includes the use of adaptation, adaptive management, adaptive planning, adaptive law, and adaptive governance, at least to some degree. This is the pathways element of hope. The hopeful nature of fourth-generation environmental law is itself an adaptive strategy for social-ecological resilience.