

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

---

Papers in Natural Resources

Natural Resources, School of

---

4-11-2019

## Untapped capacity for resilience in environmental law

Ahjond S. Garmestani

J.B. Ruhl

Robin K. Craig

Helena F. M. W. van Rijswick

David G. Angeler

*See next page for additional authors*

Follow this and additional works at: <https://digitalcommons.unl.edu/natrespapers>



Part of the [Natural Resources and Conservation Commons](#), [Natural Resources Management and Policy Commons](#), and the [Other Environmental Sciences Commons](#)

---

This Article is brought to you for free and open access by the Natural Resources, School of at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Papers in Natural Resources by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

---

**Authors**

Ahjond S. Garmestani, J.B. Ruhl, Robin K. Craig, Helena F. M. W. van Rijswick, David G. Angeler, Carl Folke, Lance Gunderson, Dirac L. Twidwell Jr, and Craig R. Allen

---



# Untapped capacity for resilience in environmental law

Ahjond Garmestani<sup>a,b,1</sup>, J. B. Ruhl<sup>c</sup>, Brian C. Chaffin<sup>d</sup>, Robin K. Craig<sup>e</sup>, Helena F. M. W. van Rijswick<sup>b</sup>, David G. Angeler<sup>f</sup>, Carl Folke<sup>g</sup>, Lance Gunderson<sup>h</sup>, Dirac Twidwell<sup>i</sup>, and Craig R. Allen<sup>j</sup>

<sup>a</sup>Office of Research and Development, US Environmental Protection Agency, Cincinnati, OH 45268; <sup>b</sup>Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht University School of Law, 3584 CS Utrecht, Netherlands; <sup>c</sup>Vanderbilt University Law School, Nashville, TN 37203; <sup>d</sup>W. A. Franke College of Forestry and Conservation, University of Montana, Missoula, MT 59812; <sup>e</sup>Wallace Stegner Center for Land Resources, S. J. Quinney College of Law, Global Change and Sustainability Center, University of Utah, Salt Lake City, UT 84112; <sup>f</sup>Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, 75007 Uppsala, Sweden; <sup>g</sup>Stockholm Resilience Centre, Stockholm University and Beijer Institute, Royal Swedish Academy of Sciences, 10691 Stockholm, Sweden; <sup>h</sup>Department of Environmental Sciences, Emory University, Atlanta, GA 30322; <sup>i</sup>Center for Resilience in Agricultural Working Landscapes, Department of Agronomy and Horticulture, University of Nebraska, Lincoln, NE 68583; and <sup>j</sup>Center for Resilience in Agricultural Working Landscapes and School of Natural Resources, University of Nebraska, Lincoln, NE 68527

Edited by Arild Underdal, University of Oslo, Oslo, Norway, and approved August 6, 2019 (received for review April 11, 2019)

**Over the past several decades, environmental governance has made substantial progress in addressing environmental change, but emerging environmental problems require new innovations in law, policy, and governance. While expansive legal reform is unlikely to occur soon, there is untapped potential in existing laws to address environmental change, both by leveraging adaptive and transformative capacities within the law itself to enhance social-ecological resilience and by using those laws to allow social-ecological systems to adapt and transform. Legal and policy research to date has largely overlooked this potential, even though it offers a more expedient approach to addressing environmental change than waiting for full-scale environmental law reform. We highlight examples from the United States and the European Union of untapped capacity in existing laws for fostering resilience in social-ecological systems. We show that governments and other governance agents can make substantial advances in addressing environmental change in the short term—without major legal reform—by exploiting those untapped capacities, and we offer principles and strategies to guide such initiatives.**

resilience | law | social-ecological systems | environmental governance

Environmental governance has made significant progress in addressing many of the challenges facing humankind, but it has not stemmed the tide of accelerating environmental change, nationally or internationally. This fact is perhaps most obvious in the limited international agreements to address climate change as both greenhouse gas emissions and atmospheric concentrations of carbon dioxide continue to increase, and biodiversity loss, nutrient pollution, and ocean acidification also signal increasing needs for reform (1). As a result, subsidiary governments (e.g., US states, provinces, regions, cities) and other governance actors [e.g., private industry, nongovernmental organizations (NGOs)] have become critical innovators (2). Nevertheless, rapidly accelerating environmental change demands further attention to national and international environmental law, particularly the need to identify and leverage the untapped capacity to enhance resilience that already exists in these laws.

Adaptive and transformative capacities are inherent characteristics of social-ecological systems that collectively influence the resilience of these systems. We use “resilience” in the sense of ecological resilience (3)—the ability of a social-ecological system to absorb change without shifting to a new regime with a different set of processes and structures. Adaptive capacity describes the potential a social-ecological system has to alter resilience in response to change and maintain the current social-ecological regime; a system with high adaptive capacity is more likely to remain resilient given substantial episodes of change (4). Transformative capacity describes the potential of a social-ecological system to shift to a different, but still productive and socially desirable, regime that is again resilient to disturbance (5). Systems with low adaptive or transformative capacity, like the Newfoundland cod fishing communities of the 1980s and 1990s, collapse in

the face of change (6). Not all social-ecological systems fully leverage their adaptive and transformative capacities, nor do they need to at all times. However, in an era of intense, novel, and disruptive environmental change, no latent capacity to adapt to change or to transform productively should remain unexplored.

Environmental law, and its ability to influence environmental governance more generally, provides 1 source of such latent capacity. Environmental governance is composed of law, policy, governance organizations, and individuals. “Law” refers to formal prescriptions, duties, prohibitions, rights, and requirements—constitutions, statutes, regulations, court decisions, rules, charters—that governmental bodies create (7). “Policy,” in turn, describes less formal goals, aspirations, and intentions (8). Finally, “governance organizations” are all of the entities that implement various kinds of law and policy from formal governmental entities (government officials, agencies, courts) to NGOs such as trade associations, corporate boards, or neighborhood associations (9).

Emerging research indicates that a key source of adaptive and transformative capacity in governance is likely to be informal, realized through networks, social processes, and cultural knowledge (5). However, researchers so far have generally overlooked the potential for more formal environmental governance components as sources of adaptive and transformative capacity, despite the fact that the United States (US) and nations of the European Union (EU) repeatedly experience some of this capacity when new US presidents or European national leaders redirect existing laws to further new government policy agendas.

## Significance

**International and national law have not stemmed the tide of rapidly accelerating environmental change. In response to this challenge, we highlight examples from the United States and the European Union of the untapped capacity of existing laws to enhance social-ecological resilience to these continual changes. The recommendations we advance regarding how to mine existing legal instruments to enhance resilience are agenda-setting, and they represent a far more feasible approach to addressing emerging environmental challenges than proposing politically untenable new laws or major amendments to existing laws. We show that governance can make substantial advances in addressing environmental change in the short term by exploiting those existing untapped capacities, and we offer principles and strategies to guide such initiatives.**

Author contributions: A.G., J.B.R., B.C.C., R.K.C., H.F.M.W.v.R., D.G.A., C.F., L.G., D.T., and C.R.A. wrote the paper.

The authors declare no conflict of interest.

This article is a PNAS Direct Submission.

Published under the PNAS license.

<sup>1</sup>To whom correspondence may be addressed. Email: garmestani.ahjond@epa.gov.

First published September 16, 2019.



not only to promote agriculture, but also to include protection of ecosystems and ecosystem services (21).

These examples suggest that a more concerted effort should be devoted to leveraging untapped adaptive and transformative capacity in existing environmental law. The question is how to do so in a manner guided by resilience principles responding to accelerating environmental change.

### Adapting Environmental Governance

Many aspects of environmental governance help to shape adaptive and transformative capacity, including budgets, leadership, and politics (5, 7). We focus here on the untapped adaptive and transformative capacity that exists within law (as defined above) and the law's ability to shape environmental governance more generally. As noted above, the acceleration of familiar and new environmental disruptions demands legal reform, but new national and international legislation is unlikely. However, governance organizations and actors can prime the pump through creative interpretations and applications of existing laws, provided there is political will to shift policies in a new direction.

Three aspects of existing law are important in this regard. First, existing law can have untapped adaptive and transformative capacity to change itself—that is, capacity to create new requirements, standards, and prohibitions in order to adapt to changing social-ecological conditions or to pursue goals that reflect a transformed social-ecological system (22). For example, existing flexibility in the US Magnuson–Stevens Fishery Conservation and Management Act can allow regional Fishery Management Councils both to adjust catch allowances as ocean water warms and to require fishers to shift their permits to new species as marine fisheries migrate poleward (23). In both cases, managers use existing statutory provisions to change the law itself in ways that both exploit the statute's resilience to changing fish stocks and strengthen the fishing community's resilience to environmental change. Of course, such flexibility has limits: The Magnuson–Stevens Act is almost useless if the fishing community needs to transform into a completely different economic and cultural identity.

Second, existing law can have the capacity to open up legal space within a social-ecological system to allow that system to more effectively exercise its own adaptive and transformative capacities. For example, if law has forced managers to keep a protected area in an increasingly artificial regime [e.g., the landscape around a protected area maintained as grassland has already transformed to a woodland (24)], existing law might be able to remove those managerial constraints, freeing the protected ecosystem's transformative capacity to respond to the changing climate.

Finally, adaptive capacities and transformative capacities within existing laws are likely to derive from the same legal provisions. As a result, there will often be considerable overlap between sources of legal adaptive capacity and legal transformative capacity because both will often depend on substantive flexibility and procedural discretion.

A concerted effort to tap into environmental law's adaptive and transformative capacities will involve 3 overarching initiatives. First, where possible under existing higher-authority laws, adaptive and transformative law mechanisms should be leveraged. Second, these legal mechanisms must be operationalized pursuant to guidelines cognizant of social-ecological realities. Third, innovations in governance organizations should be embraced when they offer potential to facilitate the first 2 initiatives.

**Leveraging Adaptive and Transformative Law Mechanisms.** Both legal systems as a whole and particular legal regimes (e.g., species protection) vary in their capacities to promote innovative approaches to environmental problems, with factors such as cyclic planning, assessing monitoring results, enforcement mechanisms, flexibility in law, the rate of statutory change, and litigation all playing roles in legal adaptive and transformative capacity (25).

Both in the United States and the European Union, these legal capacities draw from both the substantive flexibility (i.e., the goals and standards of laws) and procedural discretion (i.e., process of rulemaking and adjudication) that is built into laws (26).

Substantive legal adaptive and transformative capacity reflect the ability of a legal regime to alter its requirements, standards, and goals—large and small—in response to changed conditions. For example, federal land management agencies in the United States operate under a variety of statutorily mandated management regimes, from preservation mandates (e.g., many national monuments) to mixed conservation-commodity goals, such as the National Park Service's and the US Fish and Wildlife Service's dominant-use mandates (conservation) or the US Forest Service's and Bureau of Land Management's multiple-use mandates (manage for multiple uses as specified in the applicable statutes). Agencies operating under single- or limited-focus mandates lag behind others in terms of substantive adaptive capacity because, in particular, preservation mandates limit management options. The dominant-use and multiple-use agencies thus have found it easier to integrate adaptive management and other approaches, such as provisioning of ecosystem services, into their decision making (26, 27).

Procedural legal adaptive capacity refers to a legal regime's agility to promulgate, amend, evolve, enact, and/or implement law in light of new substantive goals and standards articulated in adapted substantive laws (28). In general, the more process required and the more checkpoints or decision makers involved, the less procedural adaptive capacity a particular area of law has (7). Thus, the common law, relying initially on the judgment of single judges, with doctrines crafted and refined over time by successive judicial opinions, is more procedurally adaptive than the legislative process (28). Nevertheless, as the European Union Water Framework Directive approach demonstrates, a legislative process can also be adaptive.

A multitude of options available under existing environmental and natural resources laws can promote adaptive and transformative capacity when deployed wisely. First, several tools already exist that increase the law's own adaptive and transformative capacity. Laws can allow or require the use of standards that automatically adjust to changing ecological conditions, promoting flexibility in environmental governance. For example, in interstate water allocation in the American West, proportional allocation of a river based on the actual yearly flow allows the affected states to adapt more easily both to drought and to longer-term changes in climate than would fixed requirements to deliver a certain amount of water at a certain place downstream (28, 29). Legislatures can also creatively employ "sunset" provisions to increase the adaptive and transformative capacity of laws. While legal sunsets often simply terminate a statute or regulation on a certain date unless the legislature or agency re-enacts that provision, legislatures and agencies can also use sunset provisions to require a more detailed review of a law at a certain point in the future. The European Union Water Framework Directive, for example, schedules review and public input every 3 to 5 y, allowing agencies to implement adaptive approaches without subverting public participation (7). Even more comprehensive review in conjunction with a termination of the existing version of a law could allow the legislature or agency to completely overhaul a sunsetted statute or regulation either to reflect transformed conditions or to guide a transformation in progress toward a productive altered system.

Second, as noted, governance entities can use existing law to create conditions that allow social-ecological systems to exercise their own adaptive and transformative capacities. For example, instead of mandating that protected areas remain in defined regimes (24), the law enabling certain protected areas can instead preserve and strengthen inherent adaptive and transformative capacities latent in social-ecological systems (27) so that they can adapt or productively transform in response to changing



social-ecological systems to various kinds of change, compared to what federal law alone would have accomplished.

In the same spirit, the EU Adaptation Strategy connects adaptation goals to a diversity of other policy fields, such as ecosystem management, disaster risk reduction, and the Common Agricultural Policy. Through this integrated approach, the European Union seeks to identify and use untapped adaptive and transformative capacities to better address environmental challenges. The strategy is focused on providing opportunities and facilitating decision-making at the local and regional level (45), in line with the elevated consideration that the European Union gives to the issue of subsidiarity and the respective roles of public and private actors.

There are efforts underway to better understand the elements of environmental governance—law, policy, governance organizations, and individuals—that are truly transformative by studying transformative capacity and governance in social-ecological systems (5). Significant, targeted investment and innovation in either the law or its implementation at timely intervention points can also serve as a catalyst for transforming social-ecological systems from degraded to more desirable conditions (5). For example, laws that set and require monitoring of social-ecological thresholds, such as the US Clean Water Act and Safe Drinking Water Act that protect drinking water supplies, can help to identify possible intervention points and thus opportunities to innovate, such as by using green infrastructure to simultaneously improve urban water quality and adapt to worsening “heat island” impacts (46).

## Conclusion

Leveraging untapped capacity for enhancing social-ecological resilience in existing environmental law has not received adequate attention. This is important, because attempts to govern social-ecological systems to date have not resulted in effective—i.e., desirable and productive—adaptation to rapidly accelerating environmental change. At the same time, transformation will become increasingly necessary, and, in many cases, social-ecological

systems cannot be restored to prior conditions (15). Thus, crafting environmental governance systems to manage the effects of environmental change across multiple ecological scales and administrative levels has been problematic. A persistent challenge for environmental governance originates from the complexity generated by scale-specific and cross-scale interactions, the occurrence of discrete but difficult to predict thresholds, and the dearth of methods to objectively assess relative resilience (47). For environmental governance to be effective, the organization of social-ecological systems across time and space needs to be accounted for in law and policy. Over time, science has developed tools useful for determining the scaling structure in ecosystems (47). An essential first step, therefore, is to communicate to policymakers the biophysical components (e.g., biodiversity, landscape structure) that influence the resilience of social-ecological systems to changing realities and how the distribution of these components within and across scales of ecosystems matters for environmental governance.

However, that is only a first step; better deployment of existing resources is also critical. We have highlighted aspects of existing environmental law that are problematic for governance of rapid environmental change. More research and action are needed, but as an interim path forward, we have highlighted some examples of the untapped potential of adaptive and transformative capacities in existing environmental laws that could enhance resilience in social-ecological systems. These existing capacities provide managers and other governance entities with tools immediately available to address the complexity and nonstationarity of social-ecological systems in a changing world.

**ACKNOWLEDGMENTS.** This work was supported by the August T. Larsson Foundation (Faculty of Natural Resources and Agricultural Sciences (NJ), Swedish University of Agricultural Sciences). The findings and conclusions in this manuscript have not been formally disseminated by the US Environmental Protection Agency and should not be construed to represent any agency determination or policy. Any use of trade names is for descriptive purposes only and does not imply endorsement by the US Government.

- W. Steffen *et al.*, Planetary boundaries: Guiding human development on a changing planet. *Science* **347**, 1259855–1259855-10 (2015).
- R. Shwom, C. Isenhour, R. C. Jordan, A. M. McCright, J. M. Robinson, Integrating the social sciences to enhance climate literacy. *Front. Ecol. Environ.* **15**, 377–384 (2017).
- C. S. Holling, Resilience and stability of ecosystems. *Annu. Rev. Ecol. Syst.* **4**, 1–23 (1973).
- D. G. Angeler *et al.*, Adaptive capacity in ecosystems. *Adv. Ecol. Res.* **60**, 1–24 (2019).
- B. C. Chaffin *et al.*, Transformative environmental governance. *Annu. Rev. Environ. Resour.* **41**, 399–423 (2016).
- R. A. Myers, J. A. Hutchings, N. J. Barrowman, Why do fish stocks collapse? The example of cod in Atlantic Canada. *Ecol. Appl.* **7**, 91–106 (1997).
- R. K. Craig, J. B. Ruhl, Designing administrative law for adaptive management. *Vanderbilt Law Rev.* **67**, 1–87 (2014).
- T. J. Lowi, Law vs. public policy: A critical exploration. *Cornell J. Law Public Policy* **12**, 493–501 (2003).
- M. P. Vandenbergh, J. M. Gilligan, *Beyond Politics: The Private Governance Response to Climate Change* (Cambridge University Press, Cambridge, UK, 2017).
- S. McCormick *et al.*, Science in litigation, the third branch of U.S. climate policy. *Science* **357**, 979–980 (2017).
- J. B. Ruhl, Ecosystem services and the Clean Water Act: Strategies for fitting new science into old laws. *Environ. Law* **40**, 1381–1399 (2010).
- J. B. Ruhl, Climate change and the Endangered Species Act: Building bridges to a no-analog future. *Boston Univ. Law Rev.* **88**, 1–62 (2008).
- J. B. Ruhl, R. J. Gregg, Integrating ecosystem services into environmental law: A case study of wetlands mitigation banking. *Stanf. Environ. Law J.* **20**, 365–392 (2001).
- J. B. Ruhl, Thinking of environmental law as a complex adaptive system: How to clean up the environment by making a mess of environmental law. *Houst. Law Rev.* **34**, 933–1002 (1997).
- M. H. Benson, R. K. Craig, *The End of Sustainability: Resilience and the Future of Environmental Governance in the Anthropocene* (Univ Kansas Press, Lawrence, KS, 2017).
- C. A. Arnold, L. H. Gunderson, Adaptive law and resilience. *Environ. Law Report.* **43**, 10426–10443 (2013).
- H. Schoukens, A. Cliquet, Biodiversity offsetting and restoration under the European Union habitats directive: Balancing between no net loss and deathbed conservation? *Ecol. Soc.* **21**, 10 (2016).
- O. O. Green *et al.*, Barriers and bridges to the integration of social-ecological resilience and law. *Front. Ecol. Environ.* **13**, 332–337 (2015).
- J. B. Ruhl, General design principles for resilience and adaptive capacity in legal systems—with applications to climate change adaptation. *North Carol. Law Rev.* **89**, 1373–1401 (2011).
- E. Kampragou, S. Apostolaki, E. Manoli, J. Froebrich, D. Assimacopoulos, Towards the harmonization of water-related policies for managing drought risks across the EU. *Environ. Sci. Policy* **14**, 815–824 (2011).
- I. Bouwma *et al.*, Adoption of ecosystem services concept in EU policies. *Ecosyst. Serv.* **29**, 213–222 (2018).
- D. Owen, Little streams and legal transformations. *Utah Law Rev.* **2017**, 1–55 (2017).
- Atlantic States Marine Fisheries Commission, Management, policy and science strategies for adapting fisheries management to changes in species abundance and distribution resulting from climate change (2018). [http://www.asmfcc.org/files/pub/ClimateChangeWorkGroupGuidanceDocument\\_Feb2018.pdf](http://www.asmfcc.org/files/pub/ClimateChangeWorkGroupGuidanceDocument_Feb2018.pdf). Accessed 21 August 2019.
- D. Twidwell *et al.*, Coerced resilience in fire management. *J. Environ. Manage.* **240**, 368–373 (2019).
- A. S. Garmestani, C. R. Allen, *Social-ecological Resilience and Law* (Columbia University Press, New York, 2014).
- A. E. Camacho, R. L. Glicksman, Legal adaptive capacity: How program goals and processes shape federal land adaptation to climate change. *Colorado Law Rev.* **87**, 709–826 (2016).
- J. B. Ruhl, Ecosystem services and federal public lands: Start-up policy questions and research needs. *Duke Environ. Law Policy Forum* **20**, 275–290 (2010).
- R. K. Craig *et al.*, Balancing stability and flexibility in adaptive governance: An analysis of tools available in U.S. environmental law. *Ecol. Soc.* **22**, 1–3 (2017).
- D. A. DeCaro, B. C. Chaffin, E. Schlager, A. S. Garmestani, J. B. Ruhl, Legal and institutional foundations of adaptive environmental governance. *Ecol. Soc.* **22**, 1–32 (2017).
- M. L. Hunter, Jr, M. J. Bean, D. B. Lindenmayer, D. S. Wilcove, Thresholds and the mismatch between environmental laws and ecosystems. *Conserv. Biol.* **23**, 1053–1055 (2009).
- M. Fournier *et al.*, Flood risk mitigation in Europe: How far away are we from the aspired forms of adaptive governance? *Ecol. Soc.* **21**, 49 (2016).

32. R. K. Craig, Constitutional environmental law, or, the constitutional implications of insisting that the environment is everybody's business. *Environ. Law*, in press (2019).
33. R. K. Craig, Dealing with ocean acidification: The problem, the Clean Water Act, and state and regional approaches. *Washington Univ. Law Rev.* **90**, 1583–1657 (2015).
34. R. K. Craig, "Stationarity is dead"—Long live transformation: Five principles for climate change adaptation law. *HELR Harvard Environ. Law Rev.* **34**, 9–74 (2010).
35. National Research Council, National Academy of Sciences, *Mississippi River Water Quality and the Clean Water Act: Progress, Challenges, and Opportunities* (National Academies Press, Washington, DC, 2008).
36. M. Wielgat-Rychert et al., Impact of the inflow of Vistula River waters on the pelagic zone in the Gulf of Gdańsk. *Oceanologia* **55**, 859–886 (2013).
37. P. A. Soranno et al., Cross-scale interactions: Quantifying multi-scaled cause-effect relationships in macrosystems. *Front. Ecol. Environ.* **12**, 65–73 (2014).
38. R. Haines-Young, Land use and biodiversity relationships. *Land Use Policy* **26S**, S178–S186 (2009).
39. J. B. Ruhl, J. Salzman, Climate change, dead zones, and massive problems in the administrative state: A guide for whittling away. *Calif. Law Rev.* **98**, 59–120 (2010).
40. A. S. Garmestani, M. H. Benson, A framework for resilience-based governance of social-ecological systems. *Ecol. Soc.* **18**, 9 (2013).
41. A. Buijze, Promoting sustainable water management in area development: A regulatory approach. *J. Water Law* **24**, 166–173 (2015).
42. K. H. Engle, Harnessing the benefits of federalism in environmental law. *Emory Law J.* **56**, 159–188 (2007).
43. R. K. Craig, Justice Kennedy and ecosystem services: A functional approach to Clean Water Act jurisdiction after *Rapanos*. *Environ. Law* **38**, 635–666 (2008).
44. C. M. Finlayson et al., *The Wetland Book* (Springer, Dordrecht, The Netherlands, 2018).
45. C. Clar, R. Steurer, Climate change adaptation at different levels of government: Characteristics and conditions of policy change. *Nat. Resour. Forum* **43**, 121–131 (2019).
46. M. A. Benedict, E. T. McMahon, Green infrastructure: Smart conservation for the 21st century. *Renew. Resour. J.* **20**, 12–17 (2002).
47. D. G. Angeler, C. R. Allen, Quantifying resilience. *J. Appl. Ecol.* **53**, 617–624 (2016).