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J. B. Ruhl [1]

ABSTRACT. Panarchy theory focuses on improving theories of change in natural and social systems to improve the design of policy responses. Its central thesis is that successfully working with the dynamic forces of complex adaptive natural and social systems demands an active adaptive management regime that eschews optimization approaches that seek stability. This is a new approach to resources management, and yet no new theory of how to do things in environmental and natural resources management, particularly one challenging entrenched ways of doing things and the interests aligned around them, is likely to gain traction in practice if it cannot gain traction in the form of endorsement and implementation through specific laws and regulations. At some point, that bridge must be crossed or the enterprise of putting panarchy theory into panarchy practice will stall. Any effort to operationalize panarchy theory through law thus comes up against the mission of law to provide social stability and the nature of law itself as a complex adaptive system. To state the problem in another way, putting panarchy theory into practice will require adaptively managing the complex adaptive legal system to adaptively manage other complex adaptive natural and social systems, all in a way that maintains some level of social order. Panarchy theorists have yet to develop an agenda for doing so. It is time for lawyers to join the team.

Key Words: *adaptive management; environmental law; panarchy theory*

INTRODUCTION

In *Panarchy: Understanding Transformations in Human and Natural Systems*, editors Lance Gunderson and C. S. Holling (2002) assemble a collection of fascinating discussions of an elaborate but ultimately compelling theory of natural and social system dynamics. The central objective of the book is to "develop an integrative theory to help us understand the changes occurring globally...particularly the kind of changes that are transforming, in systems that are adaptive" (Holling et al. 2002:5). Any such theory, they contend, "must of necessity transcend the boundaries of scale and discipline...[and] be capable of organizing our understanding of economic, ecological, and institutional systems" (Holling et al. 2002:5). They coined the name "panarchy" for their theory, after the flutist and Greek god of nature, Pan, to position it "as an antithesis to the word *hierarchy*" and to capture its "cross-scale, interdisciplinary, and dynamic nature" (Holling et al. 2002:21,5).

The contributions in *Panarchy*, however, purported to offer far more than just an abstract theory of system organization and evolution. The central thesis of *Panarchy* is that policy responses to declines in environmental quality and the growing scale of human activities have often been "flawed because the theories of change underlying them are inadequate," and that as a result, "the ultimate pathology of...traditional resources exploitation and management...is to create less resilient ecosystems, more rigid institutions, and deeper social dependencies" (Gunderson and Holling 2002:xxi–xxii). Improving theories of change in natural and social systems to improve design of policy responses is thus one of the motivating forces of the book. *Panarchy* offers the new theory of change, from which the book's contributors argue that "precautionary policies" and "adaptive management" are necessary and vitally important policy structures (Gunderson et al. 2002, Holling et al. 2002, Janssen 2002, Walker and Abel 2002, Westley et al. 2002).

This dimension of *Panarchy* raised a question that lingers a decade later: Is it really possible to translate the theory of panarchy into law, that is, into concrete legal text of the kind legislatures write, agencies enforce, and courts interpret? From theory to policy to law can be quite a long distance and the difficulty of the terrain easily underestimated. It is not easy to make law, much less law that hews closely to a theoretical ideal. For example, a legislature could not simply codify the pages of *Panarchy* verbatim, call that law, and command agencies and courts to make it so. In a civil society at least, law has to be reasonably clear, enforceable, and it has to enjoy legitimacy (Bodansky 1999, Esty 2006). How are the elaborate, dense, technical, nuanced systems theories developed in *Panarchy*, which many of the contributing authors suggest point strongly in particular policy directions, to be translated into text that meets these and the other essential qualities of law?

Panarchy offers no clues in this regard. The book leaves law and the legal discipline out of the interdisciplinary theme of panarchy theory. None of the book's contributing authors is formally trained in the law. Indeed, notwithstanding hundreds of claims throughout the chapters about the importance of policy and institutional reform, the law is scarcely mentioned anywhere in the book. One chapter briefly discusses laws as being an ingredient of the institutional component of complex ecological-economic systems (Janssen 2002), and another touches on the importance of property rights to the economics

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of resilience and sustainability (Brock et al. 2002). But that is it as far as law goes in *Panarchy.* Even the case study chapters on fisheries (Carpenter et al. 2002), rangelands (Walker and Abel 2002), and the Everglades (Gunderson et al. 2002) omit references to legal context, notwithstanding that each of those policy realms is knee deep in the governing legal text of statutes and agency regulations. Similarly, scarce mention of law can be found in the literature developing the theory of panarchy since the book's publication (but see Holling 2005), and few legal scholars have carried the theory into their work (but see Karkkainen 2005, Garmestani et al. 2008, Ruhl 2011, Cosens 2012). Why is there this failure to connect panarchy theory with the law?

To be fair, none of the editors or authors of *Panarchy* purported for their work to direct how law should be shaped and written. However, at some point, that bridge must be crossed or the enterprise of putting panarchy theory into panarchy practice will stall. Informal social norms, as powerful as they may be, would be insufficient to take on challenges as complex as management of fisheries, rangelands, wetlands, and other natural resource management questions facing the nations around the world. Even official policy proclamations cannot do the work of hard law to apply. Famously, for example, the U.S. *Clean Water Act* proclaims that "it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985" (*Clean Water Act* [33 USC 1251(a)(1)]), a goal that obviously has not been met even 25 years later than planned. The world of environmental and natural resources policy in developed nations thus is swimming in the stuff of law, i.e., codes, agencies, litigation, courts, regulations, more codes, and the sea of legal text keeps swelling. In short, no new theory of how to do things in environmental and natural resources management, particularly one that challenges entrenched ways of doing things and the interests aligned around them, is likely to gain traction in practice if it cannot gain traction in the form of endorsement and implementation through specific laws and regulations.

This is not good news for panarchy theorists. As someone trained in the law and science of ecosystems, it is my sense—my very strong sense—that translating and operationalizing panarchy theory into law will be a very difficult undertaking. There are two related reasons for my pessimism. First, dynamic, changing conditions in which uncertainty is high give law the jitters. The central theme of panarchy theory is that successfully working with the dynamic forces of complex adaptive natural and social systems demands an active adaptive management regime that eschews optimization approaches seeking stability (Holling et al. 2002). Yet one of the principal goals of law is to establish and maintain the relatively stable contexts within which other social systems (e.g., banking, health care, education, etc.) can operate over time. This is not to say that law is unchanging or is never the agent of change in other social systems, but its overall purpose is to produce more order than chaos.

The second reason panarchy theory may have difficulty finding a home in law is that law is the emergent product of a complex adaptive social system: the legal system. The legal system comprises a multitude of institutions and actors interacting and evolving over time in ways that give rise to complex system dynamics (Ruhl 2008). It is hard enough to get the legal system to produce any particular law, much less one that manages yet another complex adaptive natural or social system sustainably over time.

Any effort to operationalize panarchy theory through law thus comes up against the mission of law to provide social stability and the nature of law as a complex adaptive system. To state the problem another way, putting panarchy theory into practice will require adaptively managing the complex adaptive legal system to adaptively manage other complex adaptive natural and social systems, all in a way that maintains some level of social order. As elaborated below, this will be no mean feat. Ultimately, however, we may have no choice but to try; thus, I close with a rally call for lawyers to begin work on the law of panarchy.

DESIGNING LAW FOR PANARCHY

Panarchy is largely a call for the multi-scalar use of adaptive management in environmental and natural resources policy. Today's voluminous literature on adaptive management traces its roots to none other than C. S. Holling's (1978) seminal work, *Adaptive Environmental Assessment and Management*. The essence of adaptive management theory is an iterative, incremental, decision-making process built around a continuous flow of monitoring the effects of decisions and adjusting decisions accordingly. As Shapiro and Glicksman (2002) suggest in their review of regulatory innovations, this form of decision making allows agencies to learn about and respond to changing conditions at the "back end" rather than loading all decision making at the "front end," when the effects of decisions and of other changing conditions are not yet known. This front-end/back-end distinction captures the essence of adaptive management. The more a program directs administrative action toward fixing long-term policies and decisions based on pre-regulatory analysis, the more front-end it is. Adaptive management requires institutionalization of monitoring-adjustment frameworks that allow incremental policy and decision adjustments at the back end, where performance results can be evaluated and the new information can be fed back into the ongoing regulatory process. Deliberate monitoring and a framework for altering course, rapidly and frequently if conditions warrant, thus are essential ingredients of adaptive management.

Nothing about this is startlingly new or unusual as a general means of decision making in complex management

environments; businesses implement adaptive management all the time or they perish. However, agencies managing environmental and natural resources problems are not businesses, and as a leading proponent of adaptive management once observed, these agencies "have not often been rewarded for flexibility, openness, and their willingness to experiment, monitor, and adapt" (Grumbine 1997). Other commentators have expressed similar concerns (Iles 1996, Coleman 1998, Doremus 2001).

The deterrents to implementing adaptive management come from three fronts: legislatures, the public, and the courts, all of which have calibrated around the front-end style of decision making. For adaptive management to flourish in administrative agencies, legislatures must empower them to do it, interest groups must let them do it, and the courts must resist the temptation to second-guess when they do in fact do it. The track record of administrative law suggests that none of these three institutional constraints will yield easily to the back-end approach of adaptive management. Quite simply, there is good reason to doubt whether regulation by adaptive management is possible without substantial change in the deeply entrenched fabric of administrative law (Ruhl 2005, Garmestani et al. 2008).

Indeed, to anyone familiar with conventional administrative law, adaptive management sounds nothing like what actually happens. With broad latitude to delegate legislative power and processes to administrative agencies, legislatures intending to regulate behavior through administrative institutions exhibit a spectrum of approaches from open-ended mandates to micromanaged authority. However, one truly searches in vain for legislation that establishes anything like the decision-making cycle of adaptive management. Instead, most administrative agencies increasingly are required to engage in a tremendous amount of foreplay before promulgating a rule or adjudicating a decision (Ruhl 2005). Most of this pre-decisional activity is geared toward serving two goals: public participation and judicial review. Interest groups enter the process primarily through notice and comment opportunities, rights of participation in administrative hearings, and actions for judicial review of administrative actions. Courts engaging in such judicial review defer to agencies in many aspects of substantive outcome, but nonetheless demand thorough explanations of the rationales for agency decisions, take a hard look at how the agencies connect the dots, and show little tolerance for any procedural slips. Truly adaptive management cannot flourish among regulatory agencies in this conventional administrative law context.

Yet, as acculturated as legislatures, interest groups, and courts have become to the front-end style of decision making that has dominated for decades, few observers believe that this traditional model will have lasting success as problems such as invasive species, sprawl, and climate change take hold as the primary transmitters of environmental policy challenges. Something has to give. As the National Research Council Committee studying the Missouri River concluded (National Research Council 2002:112), adaptive management will "entail new governance structures." Ten years later, however, those new structures have yet to be outlined, much less put into place as a new form of administrative law for adaptive management. Hence, problem number one for putting panarchy theory into practice is how to design a law of adaptive management that satisfies basic norms of administrative law.

DESIGNING LAW AS PANARCHY

Panarchy also leans heavily on the theory of complex adaptive systems, i.e., the study of systems comprising a macroscopic, heterogeneous set of autonomous agents interacting and adapting in response to one another and to external environment inputs. Emerging primarily from the physical sciences in the 1980s, complex adaptive systems theory has spread to economics (Beinhocker 2006, May et al. 2008), ecology (Levin 1999), sociology (Sawyer 2005, Miller and Page 2007), and beyond. A growing number of legal scholars have begun using complex adaptive systems theory to inform understanding of legal systems (Hornstein 2005, Ruhl 2008).

Complex adaptive systems theory informs legal design theory on several levels of contextual depth. At the surface, there are complex adaptive system properties in the economy, poverty, war, terrorism, crime, environment, and other realms we attempt to manage and regulate through law. How should law be configured so as to best approach these complex social and physical systems? The answer one derives from panarchy theory is that law should operationalize adaptive management, which has its own set of challenges, but one must also look back at the legal system itself to appreciate the full magnitude of what panarchy theory demands law deliver, for law is the product of a complex adaptive system, the legal system (Ruhl 2008).

Why, for example, if the economy and other social systems exhibit complex adaptive system properties, would not the legal system? That does not seem plausible. The legal system, like these other social systems, is a vast collection of heterogeneous actors and institutions interacting dynamically over time. To push further, if the economy and the legal system are both complex adaptive systems, then one would also expect the two systems to interact in a complex way with each other, as well as with all the other complex social and physical systems with which they are interconnected; it has all the qualities of complex adaptive system evolution. And if law complexly affects the economy and other systems, and the economy and other systems complexly affect law, the distinct probability is that law affects itself complexly. In short, it defies reason to believe that the legal system would be the one social world in which the dynamics of complex adaptive systems are not at work.

As discussed above, it is difficult enough to conceive of an administrative law system that accommodates adaptive management. However, now we see also that any such legal system, once designed and set in motion must itself be adaptively managed. Like any complex adaptive system, whatever decision-making process is designed to implement adaptive management will be prone to emergent behavior difficult to have predicted at the start of the decision-making process and difficult to calibrate over time. Decision makers faithfully implementing adaptive management according to its legal text may nonetheless produce results that are volatile over the short term or which drift far from original conditions over the long term (Ruhl 2005). In either case, such volatility or drift could be perfectly appropriate adaptive responses (Karkkainen 2005) or they could lead to decisions presenting unintended consequences and substantial policy concerns, notwithstanding their adaptive pedigree. In other words, diligent implementation of an adaptive management decision-making regime does not necessarily guarantee decisions free from controversy and defects. Modeling adaptive management law around panarchy theory could, in fact, produce results no panarchy theorist would ever want. So, how do we design law to adaptively manage adaptive management? The second problem for putting panarchy theory into practice is that there has yet to be offered an adequate answer to that question.

CONCLUSION

The contributors to *Panarchy* may have underestimated the difficulty of moving from theory to policy to law, but lawyers should likewise not underestimate the need to make that move. Change is coming, and legal stasis is unlikely to be the appropriate response. Panarchy theory offers a compelling theory of change, one that matches seamlessly with the problems on environmental law's horizon. Yet the archaic front-end system of environmental law decision making stands little chance when put up against climate change, declining biodiversity, water scarcity, and the host of other emergent conditions flowing from the complexity of modern society and its impacts on the environment (Craig 2010).

Perhaps, in this sense, *Panarchy* has thrown the ball into the lawyers' court. In retrospect, the book's interdisciplinary team might have included some legal expertise, but given how much my analysis has rained on the panarchy parade, a lawyer's perspective at that time could have sent everyone home before the theory got off the ground. Law now has its job cut out for it: how to take what panarchy theory says about the world and put it into practice through statutes, regulations, and other hard law to apply.

I go no further in that effort here than to sound the alarm that work on the law of panarchy must begin in earnest. In particular, lawyers must craft a durable administrative law for adaptive management, one that satisfies norms of stability, legitimacy, public participation, and judicial review while truly allowing adaptive management to be adaptive. Other core concepts of panarchy theory, in particular the precautionary principle, also must move beyond platitudinal rhetoric and formless definition to be grounded in real-world problem contexts such as marine ecosystem management (Craig and Ruhl 2010).

The lawyers who respond to this rally call, however, must not resent being left out of the formative stages of panarchy theory. The law of panarchy will flop if lawyers seal themselves off from the panarchy theorists to frolic in legalese. Here, more than ever, an interdisciplinary effort is needed to craft a legal regime that reflects foundational principles of the motivation for the intended legal evolution, panarchy theory. Holling, Gunderson, and their fellow panarchy theorists have infrequently engaged the law, and lawyers may struggle to understand what panarchy theory is about, but we must gather around the same table and break bread. Who is with me?

Responses to this article can be read online at:
http://www.ecologyandsociety.org/vol17/iss3/art31/responses/

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