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## Panarchy and Adaptive Change: Around the Loop and Back Again

Bradley C. Karkkainen\*

### I. PANARCHY AND PROGRESS

I am both honored and a bit humbled to comment on C.S. “Buzz” Holling’s contribution to this issue. Holling’s influence on environmental and natural resources law and policy over the past several decades has been enormous. Holling pioneered the concept of “adaptive management”—or Adaptive Environmental Assessment and Management (AEAM) as he first dubbed it in his seminal 1978 work on the subject<sup>1</sup>—as a scientifically defensible, learning-by-doing, incremental and iterative approach to improving our understanding of complex ecosystems, leading to improvements in our ability to manage environmental problems in their proper ecological context.

Holling developed the adaptive management concept in response to his own frustrations as a scientist and frequent participant in interdisciplinary environmental impact assessment (EIA) teams in the 1970s.<sup>2</sup> The standard EIA approach calls for a comprehensive and synoptic environmental analysis and assessment, legally required as a prerequisite to any governmental action that “significantly affects” environmental quality.<sup>3</sup> Typically, however, only a fraction of

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1. See ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (C.S. Holling ed., 1978).

2. *Id.* at 1-2.

3. See National Environmental Policy Act §102(2)(C), 42 U.S.C. § 4332(2)(C) (2000) (requiring federal agencies to “include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement” on environmental impacts and alternatives to the proposed action).

the information needed to make such a comprehensive assessment is readily available. Data gaps are pervasive, scientific understanding of even the most basic ecological processes is often incomplete, and the integrative analyses rest on crude, untested, incomplete, and necessarily speculative ecosystem models stitched together from spotty data and disparate scraps of research findings from a variety of scientific disciplines. Worse, the validity of the predictions generated by these models is rarely tested against real-world outcomes due to a paucity of post-project monitoring. Consequently, scientists have little opportunity to refine or adjust their models over time.

Holling believed such efforts led neither to better scientific understanding nor to well-informed agency decisionmaking. For their part, agency managers seemed to have little concern for the accuracy of the assessments generated by this jerry-rigged process, so long as the legally mandatory procedures were followed.<sup>4</sup> As a legal matter, it is procedure and not substance that matters in environmental impact assessment in the United States.<sup>5</sup>

A more scientifically defensible approach, Holling argued, would be to treat environmental impact assessment not as a once-off, purely predictive exercise, but rather as an ongoing, interdisciplinary, scientific inquiry.<sup>6</sup> Teams of scientists would construct integrative models based upon the best data and research currently available, then identify gaps and uncertainties in their models and generate testable hypotheses designed to fill the gaps and reduce the uncertainties. Working with managers, the scientists would then design management interventions as scientific experiments carefully tailored to

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4. See COUNCIL ON ENVTL. QUALITY, THE NATIONAL ENVIRONMENTAL POLICY ACT: A STUDY OF ITS EFFECTIVENESS AFTER TWENTY-FIVE YEARS, at iii (1997) (concluding that many agencies act “as if the detailed statement called for in the statute is an end in itself, rather than a tool to enhance and improve decision-making”).

5. See A. Dan Tarlock, *Is There a There There in Environmental Law?*, 19 J. LAND USE & ENVTL. L. 213, 239 (2004) (describing NEPA as a “striking example of the dominance of procedure over substance,” a condition traceable to early court decisions holding that only the statute’s procedural provisions were judicially enforceable).

6. See ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT, *supra* note 1, at 133 (“Prediction and traditional ‘environmental impact assessments’ suppose that there is a ‘before and after,’ whereas environmental management is an ongoing process. . . . Environmental assessment should be an *ongoing investigation into*, not a *one-time prediction of*, impacts.”).

field-test their hypotheses against observed outcomes. The results of these “adaptive management” experiments would feed back into further refinements of the ecological models, generating subsequent rounds of testable hypotheses. Iterative application of this method, Holling argued, would lead to rolling improvements in scientific understanding and contribute in turn to better informed and continuously improving management decisions.<sup>7</sup>

It took the better part of two decades for the adaptive management concept to catch on in natural resources management, and we are yet to appreciate its full implications. Although many leading scientists and natural resources management professionals now see the need for some form of adaptive management as axiomatic,<sup>8</sup> even the most well-funded and technically sophisticated ecosystem management efforts, like those in the Florida Everglades and the San Francisco Bay-Delta, are still struggling, often awkwardly and uncertainly, to integrate adaptive management principles.<sup>9</sup>

Environmental law and policy scholars are several steps

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7. See *id.* at 11-16 (describing principal elements in an Adaptive Environmental Assessment and Management approach).

8. See Fred Bosselman, *A Role for State Planning: Intergenerational Equity and Adaptive Management*, 12 U. FLA. J.L. & PUB. POL'Y 311, 323-25 (2001) (describing rising prominence of adaptive management in ecological science); A. Dan Tarlock, *Putting Rivers Back in the Landscape: The Revival of Watershed Management in the United States*, 6 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 167, 189-92 (2002) (describing the shift in natural resources management toward regional ecosystem-scale efforts at integrated management, predicated upon adaptive management strategies).

9. See NATIONAL RESEARCH COUNCIL, COMM. ON RESTORATION OF THE GREATER EVERGLADES ECOSYSTEM, ADAPTIVE MONITORING AND ASSESSMENT FOR THE COMPREHENSIVE EVERGLADES RESTORATION PLAN 9 (2003) (concluding that monitoring, assessment, and passive adaptive management plans for the Comprehensive Everglades Restoration Project are scientifically defensible, but should be augmented with active adaptive management and measures to ensure that information reaches key decisionmakers); Thomas T. Ankerson & Richard Hamman, *Ecosystem Management and the Everglades: A Legal and Institutional Analysis*, 11 J. LAND USE & ENVTL. L. 473, 500 (1996) (concluding that “the implementation of adaptive management policies is problematic [in the Everglades] under the current environmental regulatory framework” which is predicated upon a static approach to environmental management); J.B. Ruhl, *Taking Adaptive Management Seriously: A Case Study of the Endangered Species Act*, 52 U. KANSAS L. REV. 1249, 1265-67 (2004) (stating that despite its professed commitment to an adaptive management approach, the CALFED Bay-Delta program recently acknowledged that it had failed to conduct regular status monitoring on the endangered Delta smelt, a necessary predicate for meaningful adaptive management).

further behind the curve. We are only now beginning to debate the meaning and merits of adaptive management in a serious way and to appreciate the profound and far-reaching challenge it poses to more familiar fragmentary, fixed-rule approaches to law and regulation. J.B. Ruhl's contribution to this issue is an important intervention in that debate,<sup>10</sup> which I discuss below.

Now Buzz Holling has come forth with a new and equally revolutionary concept, "panarchy." I confess that at first blush I am not entirely certain what to make of it, and suspect I am not alone in that regard. Perhaps we legal scholars are just a bit slow on the uptake, but Holling appears once again to be way out ahead of us, setting his sights on some distant and dimly perceived horizon of knowledge. And as with adaptive management, it may take us another twenty years to catch up. Holling, if you will pardon the analogy, is the Lance Armstrong of the adaptive change cycle; we feel privileged just to be somewhere far back in the pack chasing him, however futile may be the effort to catch him.

"Panarchy," as Holling and his colleagues describe it, is a cycle of adaptive change, proceeding through "forward-loop" stages of innovation, growth, exploitation, consolidation, predictability, and conservation, followed by "back-loop" phases of instability, release, collapse, experimentation, novel recombination, and reorganization.<sup>11</sup> At that point the cycle begins anew, moving once again through the forward loop, albeit beginning from a new starting point. Holling and friends schematize this cycle by simplifying it to four phases: exploitation, conservation, release, and reorganization.<sup>12</sup> This cycle, they argue, generally characterizes processes of adaptive change in both ecological and social systems.<sup>13</sup>

So far, so good. From there, though, the story becomes vexingly complex. These adaptive cycles, Holling tells us, operate simultaneously on multiple spatial and temporal scales, and across scales. Consequently, "major learned

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10. J.B. Ruhl, *Regulation by Adaptive Management—Is It Possible?*, 7 MINN. J.L. SCI. & TECH. 21 (2005).

11. See C.S. Holling & Lance H. Gunderson, *Resilience and Adaptive Cycles*, in PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS 25, 33-40, 47-49 (Lance H. Gunderson & C.S. Holling eds., 2002) [hereinafter PANARCHY]; C.S. Holling, *From Complex Regions to Complex Worlds*, 7 MINN. J.L. SCI. & TECH. 1 (2005) [hereinafter *Complex Regions*].

12. Holling & Gunderson, *supra* note 11, at 34 fig.2-1.

13. See *id.* at 62.

benefits need not, and generally do not stay in the place where they were created,” but instead “flourish elsewhere.”<sup>14</sup> Thus successful local-scale innovations might create new opportunities that are absorbed into larger forward-loop learning processes, and become diffused across larger spatial and temporal scales. By the same token, collapse at small scales might contribute to cascades of destabilization and collapse across larger scales. Or, locally adaptive successes might in some circumstances prove disruptive of larger scales of forward-loop self-organization, triggering a flip into back-loop instability and collapse at the larger scale.<sup>15</sup>

Holling and his colleagues claim to have documented the recurrence of these cyclical patterns in numerous ecological settings,<sup>16</sup> and they cite a variety of social science literature and anecdotal accounts to argue that the pattern is generally replicated in human social systems as well.<sup>17</sup>

Ultimately, of course, the panarchy thesis rests on a series of large empirical claims. Those claims, while plausible and intriguing, are difficult to verify or to rebut from the vantage point of a law professor’s desktop, and therefore I have no choice but to remain agnostic—at least for now. A few comments are nonetheless in order.

The panarchy thesis, as I understand it, is posited as a general characteristic of cycles of adaptive change. This lends a note of determinism and inevitability, something like an Iron Rule of the Figure-8 (or “double-loop”) pattern of system change. Holling and colleagues are quick to disclaim a strongly deterministic interpretation of their own thesis, labeling it a “metaphor” rather than a “rigid, predetermined path.”<sup>18</sup> But a

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14. See *Complex Regions*, *supra* note 11, at 4.

15. See Holling & Gunderson, *supra* note 11, at 60-61 (arguing that locally adaptive strategies may sometimes have maladaptive large-scale consequences, as when efforts to stabilize resource production reduce diversity and resilience, leading to collapse in the larger system).

16. See *id.* at 35-38 & box 2-2 (describing this adaptive change cycle in several ecosystem contexts).

17. *Id.* at 38, 55-60 & box 2-5 (describing adaptive change cycle in corporate management); Fikret Berkes & Carl Folke, *Back to the Future: Ecosystem Dynamics and Local Knowledge*, in PANARCHY, *supra* note 11, at 121-46 (describing panarchic adaptive changes cycles in local and traditional natural resources management regimes).

18. See Holling & Gunderson, *supra* note 11, at 51 (“The adaptive cycle in its most general form is a metaphor and should not be read as a rigid, predetermined path and trajectory—for ecosystems at least, let alone economies and organizations.”).

metaphor for what? Presumably, it is a metaphor for an observed phenomenon that, according to their thesis, recurs with predictable regularity. Holling's own writings elsewhere suggest that the exact course and direction that change takes in any particular complex dynamic system will necessarily be unpredictable, nonlinear, and stochastic,<sup>19</sup> yet the panarchy thesis seems to imply that change, however unpredictable in the particulars, will always (or almost always) follow a familiar and predictable progression of steps. The pattern, and the pattern alone, is presented as certain and more or less inescapable. Why that should be is never fully explained. To that extent, although highly abstract, the panarchy thesis seems a bit undertheorized.

Next, it is not entirely clear what to make of the role of human agency in a panarchic world, especially as it applies to human social systems. Certainly we humans play a pivotal role in social systems—and for that matter, in most ecological systems, too, given our power to dominate and displace other species and to disrupt or alter ecological processes.<sup>20</sup> Sometimes our impact stems from, or at least is modified by, conscious, intelligence-informed acts. Presumably, then, our understanding of the dynamics of system change itself has the potential to change the way we act within the system, thereby altering the trajectory of system change—though perhaps, given complexity, nonlinearity, and inherent stochasticity, in ways we cannot entirely predict or control. Holling and company do not tell us much about this, sometimes writing as if it is simply all beyond our ability to comprehend and manage, and we are all just along for the ride on the “Double Loop Panarchy Express.”

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19. See C.S. Holling, Fikret Berkes & Carl Folke, *Science, Sustainability, and Resource Management*, in LINKING SOCIAL AND ECOLOGICAL SYSTEMS: MANAGEMENT PRACTICES AND SOCIAL MECHANISMS FOR BUILDING RESILIENCE 342, 352 (Fikret Berkes et al. eds., 1998) (stating that natural resources management problems exhibit “aspects of behavior [that] are complex and unpredictable and . . . causes, while at times simple (when we finally understood), are always multiple”); see also *id.* at 346-47 (stating that in complex natural systems “uncertainty is high,” “knowledge of the system we deal with is always incomplete,” “[s]urprise is inevitable,” and “the system itself is a moving target”).

20. See Frances Westley et al., *Why Systems of People and Nature Are Not Just Social and Ecological Systems*, in PANARCHY, *supra* note 11, at 104 (describing competing theories of human domination of ecosystems, all predicated upon our unusually large capacity to change or destroy the natural environment).

The implications seem pretty scary. It is a bit like being trapped on a twenty-first century, high-tech version of a double-looping carnival ride, armed with the capacity to fiddle with the precise trajectory but only in ultimately unpredictable ways, and never able to change the basic pattern of our interminable trip: forward, up, around, down, back loop, down, around, up, forward again, and the more we try to adjust course, the more the pattern stays the same. It sounds like a mad ecologist's vision of a living hell, a *Huis clos*<sup>21</sup> of adaptive change.

Holling's earlier work on adaptive management left more room for optimism. It gave us affirmative reasons to embrace epistemic humility. Recognition that ecological systems are simply too complex to fully comprehend may have seemed debilitating at first, given a culture of regulation and resource management that assumed it was the regulator's or manager's responsibility to have all the scientifically "correct" answers before proceeding. Complexity thus initially threatened to thwart action. Adaptive management seemed to offer a way out of that box: an incremental, scientifically defensible, one-step-at-a-time methodology for learning as we go, and adjusting management measures to incorporate gains in knowledge over time.

Panarchy, on the other hand, conjures up not only intricate layers of impenetrable and seemingly unmanageable complexity, but also a sense of futility, coupled with less clarity and optimism about how to respond. The panarchy thesis seems to imply that all directed, "forward-loop," human social endeavors—adaptive ecosystem management included—are doomed to fail eventually, perhaps after an initial period of success. Despite our best efforts, the cycle from innovation through growth, exploitation, maturity, stability, and conservation appears destined inevitably to stumble into the back-loop of destabilization, disorder, and creative destruction. Every project, large or small, thus takes on an aspect of the labor of Sisyphus—or Bill Murray's *Groundhog Day* without the happy ending,<sup>22</sup> if your tastes run more to pop culture—but

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21. The reference is to Jean-Paul Sartre's existentialist play *Huis clos* (translated as "No Exit") in which three characters are condemned to spend eternity sitting on a couch conversing, even though they cannot stand each other.

22. *Groundhog Day*, a 1993 film directed by Harold Ramis, starred comic actor Bill Murray as a television weathercaster doomed to spend eternity in



either way, it is a gloomy prospect. If indeed all human undertakings are doomed to fail at unexpected times and for unanticipated reasons, why bother? Unless, of course, we are so biologically programmed that we have no other choice, which is an equally dismal thought.

But what about the “back loop” of the panarchic cycle? That idea has great intuitive appeal. We have all seen cycles of creative destruction, alternating with periods of incremental front-loop learning. The front loop imposes order and stability (at least for a while), but at the same time grows increasingly vulnerable to disturbance until suddenly everything unravels in a flurry of rapid, back-loop, creative disorganization, reorganization, and reconfiguration, leading to innovation, re-synthesis, and a new front-loop developmental pattern. It is on the back loop that the most creative and far-reaching changes are often inaugurated in the midst of seeming chaos and disintegration. This is no less true in law than in other fields of human endeavor. It took the American Revolution and a subsequent period of futility under the Articles of Confederation (back loop) to spawn a long period of relative stability under the United States Constitution (front loop); the Civil War (back loop) to generate the Reconstruction Amendments, a long period of slowly accumulating federal constitutional primacy, and steady advances in civil rights and civil liberties (front loop); the Great Depression (back loop) to produce the New Deal and the modern administrative and regulatory state (front loop).

In the environmental arena, too, it is typically periods of crisis that stimulate creative and innovative advances in policy and management. Thus it took the Santa Barbara Channel oil spill and the Cuyahoga River bursting into flames (back loop) to bring about the Clean Water Act (front loop),<sup>23</sup> Love Canal to produce CERCLA,<sup>24</sup> Bhopal to launch the Toxics Release Inventory,<sup>25</sup> and the Exxon Valdez to spur enactment of the Oil Pollution Act.<sup>26</sup> Collaborative, adaptive, and integrative

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endless repetition of the worst day of his life, covering the annual emergence of the groundhog in a backwater town—until the inevitable happy ending.

23. Michael P. Vandenberg, *The Social Meaning of Environmental Command and Control*, 20 VA. ENVTL. L.J. 191, 206 (2001).

24. *Id.* at 206 n.83.

25. See Christopher H. Schroeder, *Third Way Environmentalism*, 48 U. KAN. L. REV. 801, 818 (2000).

26. See Vandenberg, *supra* note 23, at 206 n.83.

environmental governance institutions have emerged in places like the Florida Everglades only when it became clear that incremental business-as-usual was not working, the center would not hold, and something radically new and different needed to be tried.<sup>27</sup> In short, we appear to be most open to experimentation and new thinking when we are desperate and no longer can see the way to answers through accustomed modes of thought and familiar patterns of action. Perhaps that is where, at the end of the day, a glimmer of hope is to be found in panarchy.

My friends and sometime collaborators, Chuck Sabel and Bill Simon, have written provocatively about a legal approach they call “destabilization rights.”<sup>28</sup> In Sabel and Simon’s view, sometimes it becomes necessary to use litigation to pull the plug on an established institutional arrangement when it becomes clear the institution is failing on one or more important dimensions of performance, and political blockage is preventing a significant correction through ordinary governmental processes.<sup>29</sup> Increasingly, Sabel and Simon argue, judges in “public law litigation” cases—typically constitutional or statutory civil rights or civil liberties cases seeking major institutional reforms of public schools, prisons, criminal justice systems, social welfare programs, and the like—recognize that they are not well-positioned to impose comprehensive institutional reform blueprints from the bench given the limitations of judicial competence and expertise coupled with limitations on the courts’ ability to craft and effectively enforce a new institutional order on a resistant, entrenched, governmental defendant.<sup>30</sup> So instead judges seek

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27. See generally Alfred R. Light, *Ecosystem Restoration in the Everglades*, 14 NAT. RESOURCES & ENV’T 166 (2000) (describing how an ambitious federal-state collaborative Everglades ecosystem restoration plan emerged out of the settlement of an acrimonious lawsuit over water quality standards which had taxed the resources of both state and federal governments without producing improvements in environmental quality).

28. See generally Charles F. Sabel & William H. Simon, *Destabilization Rights: How Public Law Litigation Succeeds*, 117 HARV. L. REV. 1015 (2004).

29. *Id.* at 1062 (stating that the “prima facie case for public law destabilization has two elements: failure to meet standards and political blockage”).

30. *Id.* at 1053 (“Courts found they lacked both the information and the depth and range of control to properly formulate and enforce command-and-control injunctions” which “exacerbated resistance on the part of defendants — or at least, top-down measures had little capacity to neutralize such resistance.”).

to disentrench and destabilize the offending institution, ordering its disestablishment and setting out only very general performance standards for its reconstituted successor, leaving the hard work of institutional redesign to the defendant government but retaining jurisdiction to review its progress and to order additional reforms if necessary.<sup>31</sup> This judicially imposed destabilization, Sabel and Simon argue, often opens the door to creative, multiparty collaborations in the institutional redesign and reform effort, leading to a new and improved institutional synthesis. In short, Sabel and Simon's "destabilization rights" look like a judicially triggered mechanism to get to panarchy's back loop, where creativity may flourish.

Citizen suits can sometimes perform a similar function in environmental law. Litigation—or sometimes the mere background threat of litigation—has created legal, political, and institutional crises that have forced parties to come together in new and sometimes surprising reconfigurations in the Florida Everglades, the San Francisco Bay-Delta, the southern California coastal sage scrub, and the Pacific Northwest, among others. In all these cases, legal destabilization of established ways of doing business opened the door to a new back-loop period of creative ferment, reorganization, and institutional innovation. The panarchy thesis suggests that the new institutional configurations that emerge out of this process can be expected to advance in their turn through a normal front-loop cycle of growth, consolidation, and predictability, eventually to become unstable and collapse at unexpected times and in unanticipated ways into new back loops of creative destruction.

These examples suggest an intriguing prospect: suppose we intentionally seek to build back-loop cycles of destabilization and back-loop reconfiguration into larger front-loop cycles of institutional growth and consolidation? Then the inevitable destabilization and collapse of front-loop processes need not look so frightening or debilitating. From that perspective, the panarchic double-loop comes to represent not the futile labor of Sisyphus, but a recurring cyclical pattern of alternating opportunities for back-loop creativity and front-loop consolidation—and maybe, just maybe, the opportunity for

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31. *Id.* at 1067-73 (describing the general outlines of experimentalist remedies in destabilization rights cases).

progress over time, as each turn around the double-loop incorporates and builds on learning from past trips.

Moreover, the theory also suggests that it may be possible to build smaller, controlled cycles of destabilization and back-loop creative reconfiguration into larger scale forward-loop processes, building toward greater order at the larger scale while learning as we go through a series of small-scale disturbances and innovations. That, in a sense, is what adaptive management—as Holling originally conceived it—is all about: creating small, controlled perturbations in the system through carefully crafted, hypothesis-testing management interventions, and incorporating the learning thus generated into forward-loop incremental improvements in management at the larger system-wide scale. Yet surely there will be large-scale surprises as well, leading at times to destabilization across the larger-scale system. The lesson of panarchy, however, is not to worry: change is inevitable, but back-loop destabilization is both an inevitable part of the cycle of change, as well as an extraordinary learning opportunity, a time when conditions are ripest for creativity to flourish and for learning to advance in great strides through creative recombination. Maybe this carnival ride will be fun after all.

## II. ADAPTING LAW TO ADAPTIVE MANAGEMENT

That brings me to J.B. Ruhl's thoughtful and important contribution, entitled *Regulation by Adaptive Management—Is It Possible?*.<sup>32</sup> Ruhl argues persuasively that adaptive management is fundamentally incompatible with our present paradigm of administrative law. It is only at the end of the paper, however, that Ruhl finally takes a stand in favor of modifying administrative law to accommodate adaptive management, rather than simply concluding that adaptive management is impossible in practice—a conclusion to which many administrative law scholars come to far too easily, as if administrative law were somehow immutable and eternal, or at least of constitutional stature, rather than just another statutory and judge-made legal artifact that may prove maladaptive at some point.

I have no basic disagreement with Ruhl's thesis, but I do have a couple of comments. First, I would urge that we pay closer attention to the forms and varieties of adaptive

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32. Ruhl, *supra* note 10.

management. A common theme in the scientific literature on adaptive management is the distinction between its “passive” and “active” forms. Carl Walters, a noted fisheries biologist, adaptive management theorist and practitioner, and frequent collaborator with Buzz Holling, defines “active” adaptive management as a “deliberate probing for information” through a multistep process involving integrative ecological modeling, conscious generation of testable scientific hypotheses, and field experimentation through carefully tailored management interventions designed to test specific hypotheses.<sup>33</sup> “Active” adaptive management is, then, as much about harnessing management interventions in the pursuit of science as it is about harnessing advancing knowledge in the interest of sound management.<sup>34</sup>

In contrast, “passive” adaptive management is a simpler process involving heightened monitoring of key indicators, leading to subsequent adjustments in policies in light of what may be learned through careful observation and data generation, and without the “deliberate probing” of active, hypothesis-testing experimentation.<sup>35</sup> Even “passive” adaptive management is, in Walter’s view, far superior to old-fashioned “trial-and-error” approaches in which the manager simply tries out a policy thought likely to succeed and then abandons it in favor of an alternative course of action if the first attempt fails.<sup>36</sup> Clearly, however, Walters sees a hierarchy of methods, preferring “active” to “passive” adaptive management wherever the former is possible.

It is the “passive” form of adaptive management that appears to have gained the greatest foothold in natural resources management, however, and that is the form to which J.B. Ruhl refers in his paper. Ruhl offers his own rough-and-ready definition. The “essence” of adaptive management, he says, is “an iterative, incremental decisionmaking process built around a continuous process of monitoring the effects of decisions and adjusting decisions accordingly.”<sup>37</sup> That definition comes very close to capturing Walters’ notion of

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33. CARL WALTERS, ADAPTIVE MANAGEMENT OF RENEWABLE RESOURCES 232 (1986).

34. *See id.* at 64, 232.

35. *See id.* at 232, 248-52.

36. *See id.* at 64 (characterizing “trial-and-error” as a process of “blind probing” without model-building and hypothesis-testing).

37. Ruhl, *supra* note 10, at 28.

“passive” adaptive management, turning as it does on monitoring and subsequent adjustment of policies. Ruhl also cites definitions by biologist Simon Lewin and the National Research Council that also track the “passive” rather than the “active” form of adaptive management.<sup>38</sup> None of these formulations comes close to the highly structured and rigorously science-driven form of “active” adaptive management advanced by Walters and Holling as a disciplined way of field-testing specific and carefully formulated scientific hypotheses.

As applied in the real world of natural resources management, however, what passes under the banner of “adaptive management” often does not even rise to the level of “passive” adaptive management as Walters defines it. For example, the United States Fish and Wildlife Service (FWS)—the federal agency in charge of most Endangered Species Act implementation and enforcement—uses its own idiosyncratic definition of “adaptive management” within its Habitat Conservation Plan (HCP) program. FWS defines adaptive management as consisting of a series of pre-specified contingency measures that will be adopted at pre-specified triggering thresholds if the initial effort fails to produce the expected results.<sup>39</sup> Thus, for example, an approved HCP may specify that if the population of a protected butterfly falls below a specified level, the landowner will be required to spend an additional thirty percent beyond sums already irrevocably

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38. See *id.* at 28 n.14 (citing Lewin’s definition of adaptive management); *id.* (citing National Research Council description of adaptive management); see also *id.* at 29 (describing an eight-step process of adaptive management); *id.* at 34 (schematizing adaptive management as a four-stage continuous loop process). “Active” adaptive management as defined by Walters would include the development of specific, testable scientific hypotheses and the design and implementation of management measures carefully tailored to test those hypotheses, steps mentioned nowhere in any of the definitions or description of adaptive management cited by Ruhl.

39. See U.S. FISH & WILDLIFE SERV. & NAT’L MARINE FISHERIES SERV., ENDANGERED SPECIES HABITAT CONSERVATION PLANNING HANDBOOK 3-25 (1996) (stating that adaptive management plans in HCPs should specify triggering thresholds and “a clear understanding and agreement” as to the “range of adjustments which might be required”); U.S. Fish & Wildlife Serv. & Nat’l Marine Fisheries Serv., Notice of Availability of a Final Addendum to the Handbook for Habitat Conservation Planning and Incidental Take Permitting Process, 65 Fed. Reg. 35,242, 35,253 (June 1, 2000) (stating that if an HCP “incorporate[s] an adaptive management strategy, it should clearly state the range of possible operating conservation program adjustments due to significant new information, risk, or uncertainty,” and that this range “defines the limits of what resource commitments may be required of the permittee”).

committed for purposes of removing additional invasive vegetation and replanting with native vegetation. As one commentator succinctly put it, “another word for adaptive management” as practiced by the FWS “is ‘contingency planning.’”<sup>40</sup>

Now contingency planning may be a step up in sophistication from old-fashioned management by “trial-and-error” (or “muddling through”), but it does not have the open texture, flexibility, unboundedness, and openness to surprise and unanticipated changes contemplated by advocates of adaptive management. Not only does it lack the scientific rigor and experimental flavor of “active” adaptive management, but it does not even rise to the level of “passive” adaptive management as described by Walters. It is probably not fairly characterized as “adaptive management” at all on most standard definitions of that term. To use the term Ruhl borrows from Shapiro and Glicksman,<sup>41</sup> “contingency planning” is at heart just a slightly more complex form of “front-end” decisionmaking, modified only by a relatively narrow and inflexible range for “back-end” adjustments—within parameters specified at the front end—when certain triggering thresholds (also specified at the front end) are met. Contingency planning, in short, offers little opportunity for learning and even less for rigorous scientific experimentation; ordinarily these are much more open-textured undertakings.

Be aware, then, that when FWS says “adaptive management,” it is using the term as an idiosyncratic term-of-art for ordinary contingency planning. When Buzz Holling and Carl Walters use the term “adaptive management,” they mean something very different and are generally referring to a rigorously scientific form of “active” adaptive management, unless they specify that they are talking about the “passive” variety. When J.B. Ruhl and the National Research Council use the term, they are using it in yet another sense, to mean what Walters calls “passive” adaptive management. These varied uses of the term invite confusion.

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40. Gregory A. Thomas, *Where Property Rights and Biodiversity Converge Part III: Incorporating Adaptive Management and the Precautionary Principle into HCP Design*, 18 ENDANGERED SPECIES UPDATE, 32, 33 (2001).

41. Ruhl, *supra* note 10, at 30 & n.18 (citing SIDNEY A. SHAPIRO & ROBERT L. GLICKSMAN, RISK REGULATION AT RISK: RESTORING A PRAGMATIC APPROACH (2003) for the distinction between “front-end” and “back-end” decisionmaking).

My point here is more than a mere syntactical one. We need to be careful how we use the term “adaptive management.” Participants in the debate over its meaning and merits often end up talking past each other, because different people are using the same term to mean very different things. A little more precision is advised.

Perhaps this explains, in part, the apparent paradox that lies at the heart of FWS’s HCP program, which professes simultaneously to embrace both “adaptive management” and a “no surprises” policy, the latter offering firm assurances to landowners that more will not be demanded of them at the “back end” than they agree to accept at the “front end” of the planning process. FWS insists these two principles are not in conflict. J.B. Ruhl agrees with that statement, arguing that if the landowner agrees at the front end to an HCP containing an adaptive management provision, that landowner cannot later claim at the back end to be “surprised” if the learning generated by adaptive management leads to a call for new actions—because that is precisely what the landowner agreed to.<sup>42</sup> But Ruhl’s conception of (“passive”) adaptive management is far more open-ended than FWS’s notion of adaptive-management-as-contingency-planning. If “adaptive management” means nothing more than a limited form of contingency planning, then adaptive management and no surprises are obviously not in conflict, because the full range of possible outcomes, and the conditions that will trigger each of them, have already been fully specified at the front end. There is no conflict, but there is also no adaptive management in the open-ended but “passive” sense advanced by J.B. Ruhl, much less in the “active” scientific-experimental sense advanced by Buzz Holling and Carl Walters. We are simply comparing apples, oranges, and pears and calling them all “apples.”

I have no reason to question J.B. Ruhl’s larger claim that the adversarial and litigious character of contemporary administrative law coupled with its overall tendency toward nitpicking enforcement of fixed “command-and-control” rules—especially procedural rules, which are singularly easy for courts to enforce—and its reluctance to countenance uncertainty and lack of information as the basis for agency decisionmaking are all profoundly at odds with the very concept of adaptive management. That strikes me as not only plausible, but very

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42. See Ruhl, *supra* note 10, at 47-48.



probable, and it is a very serious problem because it places law squarely at odds with science, a very uncomfortable place for environmental law in particular to find itself.

I do question, however, whether HCPs are the case that best illustrates Ruhl's point. If I am right that FWS's crabbed and idiosyncratic interpretation of "adaptive management" as a narrowly circumscribed form of front-end contingency planning should not count as true "adaptive management" at all (on standard definitions of that term), then it appears that FWS may never have really tried to incorporate genuine adaptive management (as the rest of us know it) into the HCP process. In short, HCPs are not adaptive because FWS has never really tried to make them adaptive, and not because environmental plaintiffs have knocked out a few HCPs on administrative law grounds. It is premature to declare the policy experiment a failure, because we have not yet conducted the experiment—at least, not in the HCP context.

That does nothing to make things easier for adaptive management, however. It only leads me to conclude that, so far, FWS has determined it must "talk the talk" by using the language of adaptive management to try to justify its policies to the scientific community and other informed observers, but it has not yet "walked the walk" by actually implementing a meaningful form of adaptive management in practice. It is entirely possible, though I do not know for sure, that it is not the *presence* of genuine adaptive management in the cases Ruhl describes, but rather its *absence*, that led to lawsuits.

In the beach mouse case, for example,<sup>43</sup> the agency's position seems to have been that we genuinely do not know what the impact of the proposed development on the protected species will be, but we will promise only to make upward or downward adjustments in mitigation measures within a pre-specified range, whether or not adjustments in that range will be sufficient to protect the species. In such circumstances, a lawsuit by environmentalists claiming that the agency is not entitled to reach a "finding of no significant impact" (FONSI) when it has in effect admitted that there could be a significant adverse impact on a species protected by the Endangered Species Act seems entirely reasonable. If, on the other hand, the HCP had incorporated a more open-ended form of adaptive management, promising to make whatever adjustments were

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43. See Ruhl, *supra* note 10, at 51-52 nn.98-99.

necessary to maintain a viable population in light of what is revealed by monitoring or scientific hypothesis testing, then the agency would have a more plausible claim to a FONSI, and environmentalists would presumably have less room for complaint, either on procedural grounds or with respect to the substantive outcome. In the agency's calculation, however, the No Surprises principle trumps genuine adaptive management; No Surprises is compatible only with the faux adaptive-management-as-limited-contingency-planning that the agency idiosyncratically advocates, and it is the application of that policy that both inspires the environmentalists' distrust and invites their lawsuit.

My second point is briefer. J.B. Ruhl argues that we are still a long way from drafting a National Adaptive Management Act.<sup>44</sup> That is surely right, but merely raising the idea is a positive contribution. After all, adaptive management is at bottom a set of procedural principles—simultaneously a method of inquiry and a procedural mechanism of agency decisionmaking, based on rigorous observation through monitoring (“passive”) and experimentation (“active”), reassessment, and adjustment in light of what is learned. It also requires a particular kind of justification—scientific justification based on integrative cross-disciplinary modeling and monitoring data—for changes in policies and implementation measures. In principle, at least, it does not seem so very difficult a prospect to reduce those procedures and modes of justification to a set of administrative law principles aimed at providing the transparency, accountability, and “objective boundaries” that are currently lacking. To be sure, those legal principles will diverge from the familiar administrative law principles that we have all come to know and love, or in some cases to loathe. But that does seem a manageable task. One might even envision administrative law proceeding on two tracks: ordinarily the familiar “fixed rule” track will apply, except in circumstances where the agency can justify, according to well-understood standards, shifting to the adaptive management track, and at that point a second set of adaptive management administrative law principles would kick in, requiring different procedures and further justifications for changes in the course of action. It all sounds a bit bureaucratic, but perhaps that is the price we must pay to

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44. *Id.* at 54.

reconcile science and law. Thoughtful, scientifically attuned lawyers like J.B. Ruhl will surely have a central role to play in working this all out, but it strikes me as a valuable and exciting project.

Ruhl makes a further contribution, introducing the concepts of “volatility” and “drift” to set some outer boundaries on back-end adjustments that would escape “obtrusive public participation and judicial review.”<sup>45</sup> This is a creative and novel suggestion, worthy of careful consideration. My initial reaction, though, is a bit skeptical. Ruhl would confine early changes in position to a narrow range (to constrain volatility), gradually expanding the permissible range of volatility over time, until an outer maximum range of permissible deviation from the initial position is reached (to constrain drift). This appears to leave room for much larger lurches in position as one proceeds outward in time from the starting point. It is not clear, however why large changes are more acceptable if they occur later in time, rather than early. In the beach mouse case, for example, suppose early monitoring results indicate that the initial course of action is causing dramatic declines in the species, requiring early large-scale management adjustments to prevent ecological disaster. Those kinds of problems might just as plausibly show up early as late. On the other hand, if management is maintaining a steady course for a long period of time, it might suggest that whatever management measures are being pursued are actually working fairly well. From that perspective, large deviations from a long-established and apparently successful course of management action look every bit as suspicious as earlier ones, and should be entitled to no more deference.

On the other hand, ecological science has proven itself capable of generating very large surprises at any time. Sometimes we come to appreciate that our actions have been predicated upon very basic misunderstandings of ecosystem dynamics, necessitating large-scale corrections. There is no particular reason to think those kinds of lurching advances in science will come sooner, or later, in the process. Genuine adaptive management is almost certain to be somewhat volatile, but unpredictably so as to when volatility will be required, if we give it a chance to work. Nor is “drift” outside predetermined parameters necessarily a bad thing, if it is

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45. *See id.* at 55-56.

predicated upon real advances in scientific understanding. So it is a little hard to see just what is added by using the concepts of “drift” and “volatility” as the basis for determining when to allow citizen participation and judicial review, however creative and intuitively appealing the concepts may be.

At bottom, I suspect all this goes to the question of what counts as justification. The question is not *how much* do we want to allow agencies to depart from an initial course of action, because we cannot presume that a smaller departure is the sounder course of action, or that only small departures are justifiable early but larger departures are necessarily justifiable later. The question is *when* do we want to allow such departures, of whatever magnitude. The answer, in general, is when the departures are justified by advances in scientific understanding. That is what adaptive management is all about, and that is the principle to which we must make administrative law adapt if we are to bring environmental law and policy into congruence with contemporary ecological science.