2010

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Recommended Citation
30 J. Land, Resources & Envt'l L. 229 (2010)

TRANSBOUNDARY RIVER GOVERNANCE IN THE FACE OF UNCERTAINTY: RESILIENCE THEORY AND THE COLUMBIA RIVER TREATY

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> *To come to terms with the Columbia, we need to come to terms with it as a whole, as an organic machine, not only as a reflection of our own social divisions but as the site in which these divisions play out. If the conversation is not about fish and justice, about electricity and ways of life, about production and nature, about beauty as well as efficiency, and about how these things are inseparable in our own tangled lives, then we have not come to terms with our history on this river.*
>
> Richard White[2]

INTRODUCTION

Political boundaries are drawn without consideration of river basin boundaries, as illustrated by the fact that 263 surface water resources cross international boundaries.[3] Over the next decade, several contributing factors could trigger rapid change and social and economic instability in these international watersheds, placing greater demands on competing water interests and a greater need to cooperate across jurisdictional boundaries. These contributing factors include: climate change; continued population growth; a threatened and deteriorating ecosystem; demand for non-fossil fuel energy; and aging

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1 Waters of the West is an interdisciplinary graduate and research program offering M.S. and Ph.D. degrees in three tracks: Law, Policy and Management; Science and Management; and Engineering and Science. A concurrent J.D. degree may be obtained with either degree in any track. Over 50 faculty members from six colleges participate. The initiative allowed the University of Idaho College of Law to sufficiently expand its faculty in the area of Natural Resources and Environmental Law to develop an emphasis area in addition to the concurrent degree offering.

2 RICHARD WHITE, THE ORGANIC MACHINE: THE REMAKING OF THE COLUMBIA RIVER 113 (1995).

3 Oregon State University, Program in Water Conflict Management and Transformation, Transboundary Freshwater Dispute Database, http://www.transboundarywaters.orst.edu/database/ (last visited Mar. 13, 2010).

infrastructure. Uncertainty in these factors challenges traditional approaches to governance of transboundary water resources. These approaches also rely on the certainty that historic data concerning water supply, demand, values, and ecosystem health can be used to predict the future. In addition, these traditional approaches protect sovereignty through clear rules for dividing resources rather than flexibility to adapt to change and foster system resilience.

Resilience as applied to ecological systems addresses the ability of the system to continue to provide, or return to a state in which it will provide, a full range of ecosystem services in the face of change.[4] When applied to the coupled human-ecological system (i.e. a social-ecological system), it provides an umbrella theory for integration of concepts of natural resource management with ecological response to achieve sustainability.[5] Achieving the goal of sustainability in a river basin is complicated by uncertainty in the drivers of change and the fragmentation of jurisdictions. Research to translate resilience theory into specific administrative actions may provide a road map to improving our ability to foster sustainability in our response to change in transboundary river basins.

This research is an outgrowth of the first University of Idaho College of Law Natural Resources and Environment Symposium ("the Symposium") focused on the issue of transboundary water governance in the face of uncertainty.[6] The Symposium used the natural laboratory of the Columbia Basin, shared by the United States and Canada, as a focal point for discussion. Joint operation of the river for the purposes of hydropower production and flood control is governed by a 1964 treaty ("the Treaty"). Certain flood control provisions of the Treaty expire in 2024, and either country must provide ten years' notice should it seek to terminate the Treaty. Thus efforts are underway in the basin to predict changes and to understand whether those changes warrant Treaty modification. The degree of uncertainty surrounding the drivers of change complicates efforts to predict and address changes.

With the University of Idaho College of Law and Waters of the West Program as the lead organizer, the Symposium was developed in collaboration with researchers from Oregon State University, University of Montana, University of British Columbia, and Washington State University. Representatives of the first

[4] *See, e.g.,* BRIAN WALKER & DAVID SALT, RESILIENCE THINKING: SUSTAINING ECOSYSTEMS AND PEOPLE IN A CHANGING WORLD (2006).

[5] *See, e.g.,* Brian Walker et al., *Resilience, Adaptability and Transformability in Social-Ecological Systems,* 9(2):5 ECOLOGY AND SOCIETY 2 (2004), *available at* http://www.ecologyand society.org/vol9/iss2/art5 (PDF link at top of page) ("Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks . . .").

[6] Papers presented at the Symposium are currently in draft form and not available for circulation. The Universities Consortium will be organizing these papers into a book to be published by the Oregon State University Press. In addition, the Symposium was conducted under the Chatham House Rules which require participants to avoid attribution of statements made during the Symposium. This paper will be careful to cite Symposium sources for factual information and ideas while following the Rules in avoiding attribution of statements of political position.

four of these universities and the University of Washington have joined to form the Universities Consortium on Columbia River Governance ("the Consortium").[7]

This paper proceeds as follows: Part I introduces and reviews some of the relevant work on the concept of resilience in governance; Part II uses information from the Symposium to describe the Columbia River and the 1964 Columbia River Treaty; Part III discusses changes since 1964 and the anticipated drivers of change; and Part IV concludes by applying the concept of resilience to the Columbia River Basin and laying the foundation for the next step in the research being pursued at the University of Idaho. This work includes developing models of administrative law that are integrated with the Consortium's research around the concept of resilience. These models could be applied in the Columbia Basin and other transboundary and multi-jurisdictional efforts at river governance.

I. COMPLEX SYSTEMS AND RESILIENCE THEORY

The concept of resilience made its appearance in the study of ecological systems in the work of C.S. Holling in 1973.[8] As applied to ecological systems, "[r]esilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks . . . ."[9] The theory is the outgrowth of interdisciplinary inquiry made necessary by the growing recognition of complexity.[10] This part strives to place the concept of complex systems within a context relevant to the non-scientist[11] then draws on resilience theory literature to explain why complexity requires a new approach to management. This part concludes with a discussion of resilience theory and how it informs governance of human-ecological interaction.

To begin, it is useful to understand how science disciplines grapple with, or fail to grapple with, complexity. The traditional disciplinary silos of hard science begin by assuming complexity is not a factor. Drawing from the author's former career in geochemistry, the laws of thermodynamics predict that chemical systems will conserve energy and tend toward increasing disorder.[12] When mixed together,

[7] The Consortium includes the following representatives from each university: University of Idaho: Barbara Cosens; Oregon State University: Aaron Wolf and Lynette de Silva; University of Montana: Matthew McKinney; University of British Columbia: Richard Paisley; University of Washington: Craig Thomas.

[8] C.S. Holling, *Resilience and Stability of Ecological Systems, in* 4 ANNUAL REVIEW OF ECOLOGY AND SYSTEMATICS 1, 1-24 (1973).

[9] Walker et al., *supra* note 5, at 2.

[10] *See, e.g.,* M. M. WALDROP, COMPLEXITY: THE EMERGING SCIENCE AT THE EDGE OF ORDER AND CHAOS (1992).

[11] The author provided a similar explanation in an article advocating changes to the federal court system to accommodate the complexity of the law-science interface in resolving natural resource and environmental disputes and will draw on that explanation here. *See generally* Barbara Cosens, *Resolving Conflict in Non-Ideal, Complex Systems: Solutions for the Law-Science Breakdown in Environmental and Natural Resource Law,* 48 NAT. RESOURCES J. 257 (2008).

[12] That energy can be converted from one form to another, but cannot be created or lost, i.e. is conserved, is the First law of thermodynamics. *See generally, e.g.,* N.W. TSCHOEGAL, FUNDAMENTALS OF EQUILIBRIUM AND STEADY-STATE THERMODYNAMICS (2000). That the entropy, or

chemicals will form new compounds in a lower energy state. In what is referred to by physical chemists as an "ideal system," all things achieve equilibrium: a final state with the lowest possible energy.[13] Chemists can develop mathematical equations to predict the results of reactions between different chemical combinations by assuming the behavior of an ideal system, and the product can be shown to be repeatable in controlled experiments. This is the nature of the hard sciences; outcomes can be predicted by simple rules reflected in mathematical equations.[14] Experiments in controlled environments are replicable.

Within the vast field and number of disciplines we thus refer to as "science," some individuals have sought a unifying theory which will allow for predictability in all systems.[15] For example, E.O. Wilson writes of the inception of this effort, stating:

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disorder, of a system will increase over time if no energy is added, is the second law of thermodynamics. *Id.*

[13] *See, e.g.*, *id.*

[14] For another discussion of the differences between hard and soft sciences by a legal scholar, see David E. Adelman, *The Art of the Unsolvable: Locating the Vital Center of Science for Environmental Law and Policy*, *in* LEWIS & CLARK COLLEGE OF LAW, FORUM ON LAW SCIENCE, & THE ENVIRONMENT: A MEETING OF THE MINDS (2007) (draft paper Apr. 4, 2007), *available at* http://legacy.lclark.edu/dept/elaw/objects/Adelman_LC_Art_Unsolvable_040207.pdf.

> As prefigured above, the simple answer is that the power of science depends on the nature of the problem and the strength of the tools available to analyze it. Good science ranges from the highly precise and accurate methods found in the hard sciences (*e.g.*, Newtonian physics) to heuristic models that expose general patterns in complex systems (*e.g.*, ecology). Science is thus inherently pluralistic, as the different scientific disciplines attest, and a unitary conception of environmental science is neither a desirable end nor a viable goal.

(internal citations omitted). *Id*. at 2. *See also* Holly Doremus, *Science Plays Defense: Natural Resource Management in the Bush Administration*, 32 ECOLOGY L.Q. 249, 298 (2005)

> With the right equipment, the speed of light, the pull of gravity, and the atomic weight of hydrogen, for instance, can all be measured to a very high degree of both precision and accuracy. Biological phenomena, even at the level of a single organism, are more complicated, more variable, and therefore inherently more difficult to obtain highly certain information about. Moving to the community or ecosystem level adds yet another level of variability. Unlike some physical scientists, conservation scientists often cannot, as a practical matter, test their hypotheses under closely controlled laboratory conditions. They must rely upon observations of the natural world which are both difficult to make and subject to a high degree of background variation in order to try to understand complex biological processes. Under those circumstances, while a very strong consensus may develop around the existence and general outline of general principles such as heredity or evolution, science may never produce certainty about the extent, or even the existence, of causal relationships between ecosystem decline and specific human activities.

Id.

[15] *See, e.g.*, E.O. WILSON, CONSILIENCE: THE UNITY OF KNOWLEDGE 15 (1999). "Consilience," as used by Wilson, describes a unified theory across the natural and social sciences and, in his words, means "[l]iterally a 'jumping together' of knowledge by the linking of facts and fact-based theory

> [t]he dream of intellectual unity first came to full flower in the original Enlightenment, an Icarian flight of the mind that spanned the seventeenth and eighteenth centuries. A vision of secular knowledge in the service of human rights and human progress, it was the West's greatest contribution to civilization. It launched the modern era for the whole world; we are all its legatees. Then it failed.[16]

Modern scholars engaged in the study of complex systems attribute this failure to the dismissal of complexity as a key component of the system.[17]

In contrast to the search for unity, the vast majority of scientists since the seventeenth and eighteenth centuries have sought replicable and predictable behavior in systems through reductionism—breaking those systems into their component parts.[18] Scientists coming from a disciplinary world in which reductionism prevails often attempt to describe and predict behavior in more complex systems through synthesis.[19] Thus to understand an organism, it is built from the cell up.[20] To understand the interaction between the human and natural world, we would study each in isolation, then attempt to bring those separate understandings to bear on resolution of a single environmental problem. As Wilson points out, "[t]he greatest obstacle to consilience by synthesis . . . is the exponential increase in complexity encountered during the upward progress through levels of organization."[21] The advent of high speed computing has made it easier to describe complex systems with multiple variables, but as any modeler of climate change knows, the whole is not merely the sum of the parts.

In addition to the complexity resulting from the sheer number of variables in a natural system, complexity is the result of interaction among those variables. Predictions of system behavior through synthesis from a reductionist understanding of the components built on the assumption of ideal behavior often do not match empirical observations. This is because ideal behavior assumes no interaction between components. In other words, the assumption of the reductionist viewpoint is that the behavior observed in isolation will remain unchanged in the face of greater complexity. Yet those who use empirical methods to study natural systems have found that it is often the interactions among components that define

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across disciplines to create a common groundwork of explanation" (internal citations omitted). *Id.* at 8.

[16] *Id.* at 15.

[17] *See, e.g.,* Sharachchandra Lélé & Richard B. Norgaard, *Practicing Interdisciplinarity,* 55:11 BIOSCIENCE 967, 974 (2005) ("Disagreements within the social sciences, however, are therefore extremely deep-rooted, in part because of a mistaken belief (left over from 19th-century physics) that social phenomena ought to be explained, or largely explained, by a few universal principles.").

[18] WILSON, *supra* note 15, at 68.

[19] *Id.* at 71.

[20] *Id.* at 68.

[21] *Id.* at 91.

the system. This is the very premise of the field of ecology.[22] This is why the trend in universities is toward increasing efforts at interdisciplinary research.[23]

To the scientist who studies natural systems—for example, the geologist, the geochemist, the ecologist, and the social scientist—the simple addition of system parts cannot explain empirical observations. Natural systems display states that are repeated over and over again in different settings yet cannot be predicted by the laws derived from observation of individual components of the system and the assumption of ideality. Examples range from the uniform relation between the geometry of pool/riffle sequences and meanders and the width of a river,[24] to the repeated occurrence of so-called "metastable" mineral sequences in geothermal systems[25] and ore bodies,[26] to life.[27] In the context of an ecological system, although the system may constantly move toward some (ever changing) equilibrium state, the dynamics of the system mean that equilibrium state will never be realized.[28] Instead, the observation that ecological systems evolve in a cyclical manner with key organizing processes resulting in the repetition of certain states, and thus the continuation of ecosystem services, has led to the concept of the adaptive cycle.[29] As a result, although natural systems can be described and compared with accuracy, predictability of future behavior is far more uncertain.

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[22] *See* J. DAVID ALLEN, STREAM ECOLOGY: STRUCTURE AND FUNCTION OF RUNNING WATER (1995).

[23] *See* NATIONAL ACADEMY OF SCIENCES, NATIONAL ACADEMY OF ENGINEERING, AND INSTITUTE OF MEDICINE OF THE NATIONAL ACADEMIES, FACILITATING INTERDISCIPLINARY RESEARCH, 32-33, (2005) ("If science and engineering deal with extremely complex systems, the same is true for studies of human society. How human societies evolve, make decisions, interact, and solve problems are all matters that call for diverse insights. Very fundamental questions are inherently complex.").

[24] *See* Luna B. Leopold, *Water Surface Topography in River Channels*, *in* GRAVEL-BED RIVERS, 359-387 (R.D. Hay, J.C. Bathurst & C.R. Thorne eds., 1982), *available at* http://eps.berkeley.edu/people/lunaleopold/(137%20Images)%20Water%20Surface%20Topography %20in%20River%20Channels%20and%20Implications%20for%20Meander%20Development.pdf.

[25] *See, e.g.,* Shang J. Yao & Bruno J. Zwolinski, *Studies on Rates of Nonequilibrium Processes*, *in* ADVANCES IN CHEMICAL PHYSICS: CHEMICAL DYNAMICS: PAPERS IN HONOR OF HENRY EYRING, Vol. 21, Part 2, 91 (2007), *available at* http://www3.interscience.wiley.com/cgi-bin/bookhome/114180975/ProductInformation.html; Barbara (Cosens) Gallinatti, *Initiation and Collapse of Active Circulation in a Hydrothermal System at the Mid-Atlantic Ridge, 23ºN*, 89:B5 JOURNAL OF GEOPHYSICAL RESEARCH 3275 (1984).

[26] *See, e.g.,* P.B. Redmond, M.T. Einaudi, E.E. Inan, M.R. Landtwing, & C.A. Heinrich, *Copper Deposition By Fluid Cooling In Intrusion-Centered Systems: New Insights from the Bingham Porphyry Ore Deposit*, 32:3 UTAH GEOLOGY 217-220 (2004); G.H. Brimhall, *Early Fracture-Controlled Disseminated Mineralization at Butte, Montana*, 72 ECON. GEOL. 37-59 (1977).

[27] *See generally* WILSON, *supra* note 15.

[28] WALKER & SALT, *supra* note 4, at 54 ("[t]he concept of a 'stable' or equilibrium state is a bit misleading – the system is always tending toward the current stable state, but changing conditions mean the end point (or configuration of the basin of attraction) is constantly changing, thus equilibrium is never achieved.").

[29] *See, e.g.,* Lance H. Gunderson & C.S. Holling, *Resilience and Adaptive Cycles*, *in* PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS 25-62 (Lance H. Gunderson & C.S. Holling eds., 2002).

This leads to softer answers and greater disagreement within the discipline on exactly what those answers should be.[30] This is the nature of complexity.

Consider a river. Mathematical descriptions of fluid flow in an ideal system assume no friction. Yet anyone who has run a river knows that it is the edge that defines the flow: the turbulence around a boulder or fallen log; the riffles over a gravel bed; the eddy on the inside of a curve. Indeed, friction, the component missing in ideal fluid flow, defines a river. Thus, mathematical modeling of river flow must include a term for the interaction between the water and the river bed, i.e. friction.[31] The sediment load of a river adds even greater complexity to defining river flow and channel morphology, requiring the addition of yet another disciplinary component.[32] The study of a river becomes even more complex when its development is viewed in a longer timeframe in which tectonics may play a role in shaping its morphology.[33] Key to the concept of the adaptive cycle referred to above, is the observation that it occurs at multiple scales and that simple scaling up from one level to another will not accurately describe the system.[34] Thus, an accurate description of an ecological system must also take into account interactions at multiple scales on multiple timeframes and between different scales.[35] Adding the human component to the system further increases the complexity. No one who has observed the channelization, damming, and development of our great rivers can ignore either the impact of human intervention or our inability to fully appreciate the full measure of that impact at the time the actions were taken.[36]

From the author's own research, fossil hydrothermal systems provide another example. At moderate temperatures, the flow of fluid through fractures in rock will interact to alter the mineral composition of the rock. In an ideal system, the reactions will go to a state of equilibrium between the water and rock, and the resulting mineral assemblage is predictable.[37] But in a real system, fluid flow is often faster than the rate of chemical exchange between rock and water, thus the

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[30] *See also* Holly Doremus & A. Dan Tarlock, *Science, Judgment, and Controversy in Natural Resource Regulation*, 26 PUB. LAND & RESOURCES L. REV. 1, 18 (2005) (additional discussion of this issue by a legal scholar with a biology background) ("First, as sensible ecologists have constantly warned, ecology and the related biological sciences will never reach the precision and elegance of physics and mathematics.").

[31] The term for friction is found in the St. Venant equations used to handle river flow. ADEMAR-JEAN-CLAUDE BARRÉ DE SAINT-VENANT, THÉORIE DU MOUVEMENT NON-PERMANENT DES EAUX AVEC APPLICATION AUX CRUES DES RIVIÈRES ET À L'INTRODUCTION DES MARÉES DANS LEUR LIT 73 (1871).

[32] *See, e.g.*, W.E. Dietrich, P.A. Nelson, E. Yager, J.G. Venditti, M.P. Lamb, & L. Collins, *Sediment Patches, Sediment Supply and Channel Morphology*, *in* RIVER, COASTAL AND ESTUARINE: MORPHODYNAMICS 79-90 (G. Parker & M.H. Garcia eds., 2006).

[33] *See, e.g.*, Chris Paola et al., *Toward a Unified Science of the Earth's Surface: Opportunities for Synthesis Among Hydrology, Geomorphology, Geochemistry, and Ecology*, 42 WATER RESOURCES. RESEARCH, W03S10 doi:10.1029/2005WR004336 (2006), *available at* http://www.agu.org/journals/wr/wr0603/2005WR004336/.

[34] Gunderson & Holling, *supra* note 29, at 26.

[35] *Id.*

[36] *See, e.g.*, JEFFREY MOUNT, CALIFORNIA RIVERS AND STREAMS (1995); W.E. Dietrich & J.T. Perron, *The Search for a Topographic Signature of Life*, 439 NATURE 411, 411- 419 (2006).

[37] *See, e.g.*, Gallinatti, *supra* note 25, at 3284.

system will not have time to achieve equilibrium.[38] The addition of kinetic information, i.e. information on the rate at which a particular reaction at a particular temperature will occur, to a model of water-rock interaction vastly improves the predictability of the intermediate or "metastable" results.[39] However, simply adding kinetic information to a model built from a reductionist understanding of the system will not predict the repeated occurrence of the same metastable minerals observed over and over again in different natural systems that could not possibly have had the exact same rate of fluid flow. Could it be that some other factor defined by the very nature of the interaction between rock and moving water determines the outcome?[40] It is the possibility, in fact the belief by some, that interactions define natural systems, which has led to the development of new disciplines, such as ecology, at the point of interaction, rather than disciplines based on synthesis within the hard sciences.

These examples of complexity and non-ideal behavior at the intersection between system components should not be unfamiliar to the reader who studies the law. The very need for law rests on the complexity of human interaction. A single human alone on an island needs no law. It is the determination of the rights of one human being or group relative to those of another that gives rise to civil law. Rarely are the facts of a legal dispute identical to one that has already been decided, yet often lawyers can predict the outcome of a new case based on the similarity of key controlling features to those of prior cases. The law provides this

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[38] *Id.* at 3284-3288.

[39] *See, e.g.,* N. Shikazona, *Water-Rock Interaction and Mass Transfer in Hydrothermal Systems: Kinetics, Fluid Flow, and Mixing Model*, *in* WATER DYNAMICS: 3RD INTERNATIONAL WORKSHOP ON WATER DYNAMICS, 125-128 (2006), *available at* http://scitation.aip.org/proceedings/ confproceed/833.jsp/Table of Contents/Full Text.

[40] This has also been referred to as a problem of scale, as David Adelman notes:

> Simon Levin, an ecological modeler and theorist, describes this approach with characteristic clarity:
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> > This is the principal technique of scientific inquiry: by changing the scale of description, we move from unpredictable, unrepeatable individual cases to collections of cases whose behavior is regular enough to allow generalizations to be made. In so doing, we trade off the loss of detail or heterogeneity within a group for the gain of predictability; we thereby extract and abstract those fine-scale features that have relevance for the phenomena observed on other scales.
>
> . . . One implication of this approach is that not all levels of abstraction for analyzing a problem are created equal. Just as it would be foolish to try to study the behavior of a gas by attempting to follow the motion of every single gas molecule, so too may it be futile to attempt to understand biodiversity by tracking populations of individual species. Consideration of scale matters for basic scientific understanding and for very practical problems of effective environmental management. In fact, the two are closely linked because identification of strong associations (i.e. patterns) through basic scientific work makes environmental management possible.

Adelman, *supra* note 14, at 8 (internal citations omitted).

degree of certainty and predictability as a result of social contract, not natural law. Yet it nevertheless mimics the behavior of complex natural systems in which multiple variables must be sorted and weighed to determine their importance to the future activity of the system.

Resilience theory provides a framework for understanding complexity within an ecological system and for developing governance to enhance the resilience, and thus sustainability, of the social-ecological system. When applied to ecological systems without a human component, resilience theory focuses on both the capacity of the system to return to its prior level of self-organization following a disturbance,[41] and the degree to which that capacity is influenced by or sensitive to changes at smaller and larger scales.[42] When applied to social systems, resilience is the "ability of human communities to withstand and recover from stresses."[43] Recently, scholars have recognized that application of the theory to social-ecological systems has merit, but that the theory must be modified to account for the possibility that free-will in the social component can be used to enhance or reduce system resilience.[44] Thus, Walker et al. describe this as the ability of humans to manage for resilience in the face of change through either adaptation or transformation of the system to another desirable state.[45] Folke et al. describe both the social and ecological components as combined aspects of resilience.[46] Both groups start from the assumption that a social-ecological system is not unlike an ecological system in having key controlling processes that result in self-organization of the system.[47] In this context, the ability of humans to choose can function to facilitate resilience or push a system toward a more rather than less resilient path, but the human intervention does not replace the self-organizing system.

In contrast, Andries et al. find it awkward to apply the concept of resilience to a system that includes conscious management and design; they have adopted the term "robustness" to apply to social-ecological systems in which human design is the dominant factor.[48] Consider that these differences in terminology can be thought to be on a spectrum—at one end we have the built environment, e.g. cities,

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[41] Referred to as the "latitude," "resistance," and "precariousness" of the system. *See* Walker et al., *supra* note 5, at 2-3.

[42] *Id. See also* Gunderson & Holling, *supra* note 29.

[43] Stockholm Resilience Center, Resilience Dictionary, http://www.stockholmresilience.org/research/whatisresilience/resiliencedictionary.4.aeea46911a3127427980004355.html (last visited Mar. 1, 2010).

[44] Walker et al., *supra* note 5. *See generally* Carl Folke et al., *Adaptive Governance of Social-Ecological Systems*, 30 ANNUAL REV. ENVIRON. RESOURCES. 441 (2005). For a simple and concise explanation of resilience theory and its application to real world systems, see generally WALKER & SALT, *supra* note 4.

[45] *See* Walker et al., *supra* note 5.

[46] Folke et al., *supra* note 44, at 443.

[47] C. S. Holling, *Understanding the Complexity of Economic, Ecological and Social Systems*, 4 ECOSYSTEMS 390, 391 (2001).

[48] *See* John M. Anderies et al., *A Framework for Robustness of Social-ecological Systems from an Institutional Perspective*, 9(1) ECOLOGY AND SOCIETY 18 (2004), *available at* http://www.ecologyandsociety.org/vol9/iss1/art18 (PDF link at top of page).

in which robustness might come from mimicking ecological processes in areas such as flood control, building design for water capture, water re-use, riparian area protection or restoration—to the other end of the spectrum, in which we have an ecological system functioning with human influence only at scales above or below it. An example of this is the Arctic National Wildlife Refuge, where external human activities influencing processes such as climate change or caribou migration will have impacts. In between, you might find the Columbia River, as Richard White calls it: "an organic machine."[49]

The Columbia River has aspects of both the highly designed environment including dams, diversions, hatcheries and development in the riparian corridor, but the river also has an ecological system that continues to function and adapt. If, as the possibility is discussed below in assessments of the health of the anadromous fish populations, the system has already lost its resilience as an ecological system, then we must either move toward robustness in design and accept that challenge, or determine how to move back toward a resilient system.[50] It is important to note that the choice of which approach to adopt is a reflection of culture and values, not science.

In resilience literature, scholars use the term governance to describe the laws, policies, regulation, institutions and institutional structure involved in governing.[51] The term "adaptive management" has been used to describe a process of learning through monitoring ecosystem response to a particular action, followed by incremental change in the action based on what is learned.[52] The concept of "adaptive governance" includes the process of feedback to a managing agency from monitoring the response of the ecosystem, but it also adds the collaboration and cooperation across different levels of government, non-governmental and individual action, and among agencies within the same level of government with overlapping authority.[53] By viewing governance in a way that recognizes the social and ecological systems as linked, resilience can be enhanced both from the natural

[49] *See* White, *supra* note 2.

[50] It should be noted that engineered solutions may never capture the full complexity of a natural system and that designs for robustness may be valuable only as a temporary state while the long term goal is returning function of the natural system. *See, e.g.*, Sandra Zellmer & Lance Gunderson, *Why Resilience May Not Always be a Good Thing: Lessons in Ecosystem Restoration from Glen Canyon and the Everglades* 87 NEB. L. REV. 893 (2009).

[51] *See, e.g.*, Folke et al., *supra* note 44, at 444 ("Governance is the structures and processes by which people in societies make decisions and share power."); Dave Huitema et al., *Adaptive Water Governance: Assessing the Institutional Prescriptions of Adaptive (Co-)Management from a Governance Perspective and Defining a Research Agenda*, 14(1) ECOLOGY AND SOCIETY 26, 2 (2009), *available at* http://www.ecologyandsociety.org/vol14/iss1/art26/ ("[W]e take governance to mean 'the whole range of institutions and relationships involved in the process of governing.' This includes both formal institutions, such as laws, official policies, and organizational structures, and informal institutions: the power relations and practices that have developed and the rules that are followed in practice." (citation omitted)).

[52] *See* Folke et al., *supra* note 44. *See also* Huitema et al., *supra* note 51; Kai N. Lee, *Appraising Adaptive Management*, 3(2) CONSERVATION ECOLOGY 3 (1999), *available at* http://www.consecol.org/vol3/iss2/art3/.

[53] Folke et al., *supra* note 44, at 453.

adaptive capabilities of the ecological system and from the ability of the social system to respond to an ecological problem by seeking to restore the ecosystem.[54]

This view of governance involving ecological systems—as requiring approaches that recognize the complex feedback between the social and the ecological system differs from the traditional approach to natural resource management that involves a one-way flow of management by the social system with services from the ecological system in return. Similar to the problems faced by the natural sciences discussed above, natural resources management suffers from the failure of synthesis to accurately represent the behavior of the system. The failure of management through "optimization" to retain the full range of ecosystem services is a key message of scholars working on the concept of resilience.[55] Thus, Walker and Salt assert,

> . . . if there is one lesson to be taken from this book it is this: optimization (in the sense of maximizing efficiency through tight control) is a large part of the problem, not the solution . . . . When we aim to increase the efficiency of returns from some part of the system by trying to tightly control it, we usually do so at the cost of the system's resilience. Other parts of the system begin to change in response to this new state of affairs—a part of the system, now constant, that used to vary in concert with others. A system with little resilience is vulnerable to being shifted over a threshold into a new regime of function and structure. And, as we've seen, this new regime is frequently one that doesn't provide us with the goods and services we want. And, very importantly, it is not a space from which we can easily return.[56]

Adaptive governance moves from a focus on efficiency and lack of overlap among jurisdictional authorities, to a focus on diversity, redundancy, and multiple levels of management that include a role for local knowledge and local action. The concept that overlap and diversity among jurisdictions with authority to manage the same ecological resource is preferable to hierarchical management with clear

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[54] *See* Zellmer & Gunderson, *supra* note 50, at 897. Addressing environmental problems across multiple jurisdictions is under discussion by scholars looking through the lens of numerous theoretical constructs. *See, e.g.*, J.B. Ruhl & James Salzman, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: Guidelines for Whittling Away*, 98 CAL. L. REV. 1 (forthcoming 2010) (earlier version *available at* http://ssrn.com/abstract=1280896). This author prefers the language and nuances of the resilience literature because it ties directly to the coupled complexity of the social ecological system rather than viewing governance as a feature independent of the ecologic system it manages. *See, e.g.,* Folke et al., *supra* note 44, at 443 (citing LINKING SOCIAL AND ECOLOGICAL SYSTEMS: MANAGEMENT PRACTICES AND SOCIAL MECHANISMS FOR BUILDING RESILIENCE (F. Berkes & C. Folke eds., Cambridge Univ. Press 1998)) (for use of "the term 'social-ecological' system to emphasize the integrated concept of humans in nature and to stress that the delineation between social and ecological systems is artificial and arbitrary. Research suggests that social-ecological systems have powerful reciprocal feedbacks and act as complex adaptive systems.").

[55] Zellmer & Gunderson, *supra* note 50.

[56] WALKER & SALT, *supra* note 4, at 141.

divisions in authority is referred to as "polycentric governance" in adaptive management scholarship,[57] and "legal pluralism" in legal scholarship.[58] In adaptive governance, it is important to have a mechanism for coordination that can work at the scale of the particular ecological system involved (e.g. the basin scale for a river system), but it is not as important to designate a single entity with authority at that scale. More importantly, designation of an entity with authority at the scale of the particular ecological system may serve as the mechanism for coordination at that scale, but it is not a replacement for diversity in governance at multiple scales.[59]

In addition to a focus on institutional diversity, both the concept of polycentric governance and legal pluralism view local capacity building for purposes of self-governance as key to effective governance.[60] Achieving this would not only require the infusion of education and resources at the local level, but local authority within the decision making network. Unlike the move for local control in past western U.S. efforts, such as the Sagebrush Rebellion and the county supremacy movement, which advocate total local control over local natural resource issues concerning federal land,[61] polycentric governance would mean granting a larger voice and decision making power locally while retaining a network with state and federal government. Again, this redundancy in government, viewed as inefficient in the past, enhances the resilience of government to adapt to change.

The rise in the expectation for public involvement in government decision making since the 1960s with respect to natural resources in the United States and other democratic nations, and the incorporation of this concept in the law, will be discussed in Part III. As will be discussed, adaptive governance requires more than

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[57] *See* Huitema et al., *supra* note 51, at 3 (providing an excellent literature review on the work in this area beginning in the 1960s which will not be replicated here).

[58] *See generally* LIQUID RELATIONS: CONTESTED WATER RIGHTS AND LEGAL COMPLEXITY (Dik Roth, Rutgerd Boelens, & Margreet Zwarteveen eds., Rutgers University Press 2005).

[59] Huitema et al., *supra* note 51, at 11

> There is little empirical evidence for the effectiveness of the river-basin approach, either in its monocentric form (unitary river-basin authorities) or its polycentric form (collaboration at the basin scale), in the literature discussed here. Dinar et al. suggest that basin-level governance institutions are a necessary but insufficient condition for successful resource management, meaning that the absence of such institutions will lead to the failure of management but their presence does not necessarily lead to success.

(internal citations omitted).

[60] *Id.* at 3. *See also* G.T. (Tom) Raadgever et al., *Assessing Management Regimes in Transboundary River Basins: Do They Support Adaptive Management?*, 13(1) ECOLOGY AND SOCIETY 14 (2008), *available at* http://www.ecologyandsociety.org/vol13/iss1/art14/; Susan S. Hanna, *Institutions for Managing Resilient Salmon (Oncorhynchus Spp.) Ecosystems: The Role of Incentives and Transaction Costs*, 13(2) ECOLOGY AND SOCIETY 35 (2008), *available at* http://www.ecologyandsociety.org/vol13/iss2/art35/.

[61] *See, e.g.*, University of Nevada Reno Special Collections, *A Guide to the Records of the Sagebrush Rebellion*, Collection No. 85-04, *available at* http://www.knowledgecenter.unr.edu/spe coll/mss/85-04.html.

public comment. The phrase used in the literature is "meaningful public comment,"[62] and refers both to a two way flow of information in which governmental agencies work not only to provide information from their own expertise, but to also incorporate local knowledge and work towards a greater role for public input in decision making.[63]

Before turning to the Columbia River Basin, it is important to discuss some of the concerns identified with a polycentric approach to governance. These include the concern that redundancy leads to both loss of efficiency and accountability in decision making.[64] Changes in administrative law can be useful in addressing both problems. Loss of efficiency presents both a political problem in selling the cost of redundancy in governance to the public and a problem with transaction costs associated with communication and coordination among diverse entities (the connect the dots problem currently at issue in homeland security). Redundancy costs can be offset by viewing the ecological system as providing a complete range of ecosystem services. Thus efficiency, when equated with optimization for a limited range of ecosystem services (e.g. hydropower and flood control), when viewed in the whole context of the social-ecological system, may prove to be the more costly approach. The problems associated with valuing ecosystem services are the subject of numerous articles and research efforts,[65] and are beyond the scope of this Article except to note that the change in accounting to reflect the full range of ecosystem services is a necessary step in changing governance to facilitate resilience. Accountability, on the other hand, is an appropriate area of inquiry for those seeking solutions in the administrative law. It is crucial to the function of a democratic system and, therefore, will be one of the key focuses of development of models for administrative law to achieve resilience that will be the outgrowth of the second phase of this research.

In their excellent review of the literature, Huitema et al. find no concrete evidence that polycentric governance is more flexible and less vulnerable (key goals for facilitation of resilience) than traditional, hierarchical forms of governance, but that numerous case studies do suggest the effectiveness of the polycentric approach for large-scale "common pool" resources.[66] As a legal scholar, I do not find this lack of ability to monitor and provide quantitative proof of effectiveness as disturbing as my science colleagues might. The very nature of

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[62] MATTHEW MCKINNEY & WILLIAM HARMON, THE WESTERN CONFLUENCE: A GUIDE TO GOVERNING NATURAL RESOURCES 142 (2004).

[63] *Id.*

[64] Huitema et al., *supra* note 51, at 3.

[65] *See, e.g.*, U.S. FOREST SERVICE, VALUING ECOSYSTEM SERVICES: CAPTURING THE TRUE VALUE OF NATURE'S NATURAL CAPITAL (2007), *available at* http://www.fs.fed.us/ecosystemservices/pdf/ecosystem-services.pdf. For more general discussions of ecosystem services, see J.B. Ruhl, *The "Background Principles" of Natural Capital and Ecosystem Services – Did* Lucas *Open Pandora's Box?* 22 J. LAND USE & ENVTL. L. 525 (2007); SALLY COLLINS & ELIZABETH LARRY, U.S. FOREST SERVICE, CARING FOR OUR NATURAL ASSETS: AN ECOSYSTEM SERVICES PERSPECTIVE (2007), *available at* http://www.fs.fed.us/ecosystemservices/pdf/collins_larry.pdf.

[66] Huitema et al., *supra* note 51, at 4. *See also* NANCY LANGSTON, WHERE LAND AND WATER MEET (2003) (providing a case study of the Mahleur basin in Oregon).

complexity in social-ecological systems and the fact that no two large-scale systems are exactly alike, nor is the same system identical at two different points in time, renders it impossible to make a controlled comparison of polycentric and hierarchical governance. Thus, in applying the concept of resilience to the Columbia River, I rely on case studies, conducted by myself and other scholars, to attempt to derive lessons for why a particular approach works or does not work and why it might or might not be applicable to the Columbia River Basin.

II. THE COLUMBIA RIVER AND THE 1964 TREATY

The Columbia River Basin covers 259,500 square miles with 15% in Canada and the remainder in the United States.[67] Portions of seven states, Washington, Oregon, Idaho, Montana, Nevada, and Wyoming, lie within the Columbia River basin. Although only 15% of the basin lies within the Canadian province of British Columbia, 38% of the average annual flow and 50% of the peak flow measured at The Dalles (located on the mainstem between Oregon and Washington) originates in Canada.[68] In addition, due to the later runoff from snowpack, flow originating in Canada can be 50% of the late summer flow.[69] To express runoff from the Columbia River basin in terms of its average annual flow of 200 million acre-feet at the mouth would be misleading. The year-to-year variability in unregulated peak flow is 1:34, compared to a mere 1:2 on the Saint Lawrence River or 1:25 on the Mississippi River.[70] This variability translated to substantial storage need in the eyes of early twentieth-century boosters and engineers.[71]

In 1805 when Lewis and Clark made their way down the Columbia River to Astoria, there were no dams. Salmon fisheries sustained the native population. Falls slowed upriver migration of salmon and provided excellent fishing locations. Each year thousands of Native Americans from numerous tribes gathered at locations such as Celilo Falls (now inundated by water behind The Dalles Dam) to fish and trade.[72] Competition from commercial fishing and an influx of canneries began in 1866. The U.S. Army Corps of Engineers began transforming the Columbia River for navigation with locks at the Cascades as early as 1896, with

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[67] James Barton & Kelvin Ketchum, *Columbia River Treaty: Managing for Uncertainty, in* TRANSBOUNDARY RIVER GOVERNANCE IN THE FACE OF UNCERTAINTY: THE COLUMBIA RIVER TREATY [hereinafter "COLUMBIA SYMPOSIUM"] (forthcoming 2010) (draft article at 1, on file with author).

[68] John Shurts, *Rethinking the Columbia River Treaty, in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article at 7, on file with author).

[69] Alan Hamlet, *The Role of Transboundary Agreements in the Columbia River Basin: An Integrated Assessment in the Context of Historic Development, Climate, and Evolving Water Policy, in* CLIMATE AND WATER: TRANSBOUNDARY CHALLENGES IN THE AMERICAS 23 (H. Diaz & B. Morehouse eds., 2003).

[70] *Id*.

[71] *See generally* Paul W. Hirt & Adam M. Sowards, *The Past and Future of the Columbia River*, *in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article at 6, on file with author).

[72] DAN LANDEEN & ALLEN PINKHAM, SALMON AND HIS PEOPLE, A NEZ PERCE NATURE GUIDE 1 (1999). *See also* Paul Hirt, *Developing a Plentiful Resource: Transboundary Rivers in the Pacific Northwest, in* WATER, PLACE, & EQUITY 147, 155 (John M. Whiteley et al. eds., 2008) (noting that pre-European settlement salmon runs were estimated at 12-15 million salmon).

numerous dams to follow.[73] Most dams in the U.S. portion of the river mainstem served to generate hydropower and aid navigation, but did not store substantial water.[74] Exceptions to this run-of-the-river approach were the Grand Coulee Dam, a BOR facility, completed on the mainstem in 1942 for irrigation that permanently blocked salmon runs from reaching Canada and the Hungry Horse Dam completed on a tributary, the South Fork of the Flathead, in 1953.[75] In 1948, even though the total flow was close to average, runoff occurred rapidly and peaked with a flood in May that destroyed the town of Vanport, Oregon with estimated flow of over 1 million cubic feet per second ("cfs"), (average peak flows are less than half that rate).[76] At the time of the 1948 flood, total storage capacity on the Columbia was about 6% of the average annual flow.[77] Compare this to the Colorado with a storage capacity of over four times its average annual flow or the Missouri with storage capacity over two times its average annual flow.[78] The U.S. Army Corps of Engineers is, or at least was at the time, accustomed to addressing flood control through storage. The problem: the best remaining storage sites were in Canada.

Even before the 1948 flood, the International Joint Commission formed by the 1909 Boundary Waters Treaty between the United States and Canada, was directed to study the possibility of storage within Canada to provide flood control or power benefits to both countries.[79] The Columbia River Treaty[80] ("the Treaty" or "the Columbia River Treaty") that would form the framework to accomplish this task was not adopted until 1964. Possibly the biggest obstacle to its completion was the fact that the three new dams contemplated would all be in British Columbia and the majority of the flood control and hydropower benefits would be in the United States.[81] Between 1961 and 1964 negotiations between the federal government of Canada and the province of British Columbia led to a solution that would turn the operation and benefits under the Treaty over to the province and divide benefits between the U.S. and the province.[82] The resulting solution has been held throughout the world as the pinnacle of international cooperation on freshwater sources.[83] The Treaty would provide for three dams to be built in Canada: Mica,

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[73] WHITE, *supra* note 2, at 37.

[74] Shurts, *supra* note 68, at 7.

[75] *Id.*

[76] Barton & Ketchum, *supra* note 67, at 4.

[77] Anthony White, *The Columbia River, Its Treaties and Operation*, *in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article at 1, on file with author).

[78] Barton & Ketchum, *supra* note 67 (draft article at 4, on file with author).

[79] Jeremy Mouat, *The Columbia Exchange: A Canadian Perspective on the Negotiation of the Columbia River Treaty*, *in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article at 1, on file with author); Shurts, *supra* note 68, at 6-7.

[80] Treaty Between Canada and the United States of America Relating to Cooperative Development of the Water Resources of the Columbia River Basin ("Columbia River Treaty"), U.S.-Can., Jan. 17, 1961 *available at* http://www.ccrh.org/comm/river/docs/cotreaty.htm [hereinafter Columbia River Treaty].

[81] Mouat, *supra* note 79, at 9; Shurts, *supra* note 68, at 6-7.

[82] Mouat, *supra* note 79, at 9-15; Shurts, *supra* note 68, at 7-8; Hirt & Sowards, *supra* note 71, at 17.

[83] Barton & Ketchum, *supra* note 67, at 1.

Duncan, and Keenleyside; a payment of $65 million from the United States to Canada for flood control; and a 50/50 division of the benefit of the additional hydropower generated in the United States due to release from the three new dams with the Canadian share referred to as the "Canadian Entitlement."[84] In addition, the Treaty allowed the United States to build Libby Dam on the Kootenai River, which would back water into Canada.[85] Finally, the Treaty provided for appointment of operating entities by the United States and British Columbia. The U.S. selected the U.S. Army Corps of Engineers and the Bonneville Power Administration.[86] British Columbia selected BC Hydro.[87]

One further complication would need to be addressed before the Treaty could be completed. In 1964 the Pacific Northwest did not require the amount of power the new projects would generate. This was solved when Congress authorized construction of the Pacific Northwest-Pacific Southwest Intertie allowing sale of power to utilities in the southwestern United States, with a preference for sale to northwest utilities.[88] Thirty-year contracts for sale of hydropower to the southwestern United States were entered with a payment to Canada of $254 million, enough to cover dam construction.[89] Although this payment was based on the estimated present value of the anticipated power sales, it would not come close to the actual value that would have been realized on renewable contracts over the same thirty year period.[90] Choosing certainty, even in the face of potential gain through a more flexible relationship, is a common theme in multi-jurisdictional agreements and will be discussed further in the application of resilience concepts to the Columbia River Basin in Part IV.

The Treaty contains no automatic termination date or renegotiation clause and 2024 is the earliest date either party may terminate.[91] At least ten years notice must be provided,[92] hence the importance of a thorough review of the Treaty before the year 2014. The operating entities are undertaking studies to inform options to be explored by 2014, and have announced that a process of stakeholder input will begin on completion of technical studies.[93] However, certain of the flood control provisions, paid for upfront by the United States to cover sixty years, expire in 2024.[94] This alone has led to consideration of whether the time is ripe for modification of the Treaty.[95] A logical starting point in this consideration is to

[84] Columbia River Treaty, *supra* note 80, Art. V.
[85] *Id.* Art. XII.
[86] Exec. Order No. 11,177, 29 Fed. Reg. 13097 (Sept. 16, 1964).
[87] Barton & Ketchum, *supra* note 67, at 2.
[88] Pacific Northwest Consumer Power Preference Act, 16 U.S.C. § 837 (2006).
[89] Shurts, *supra* note 68, at 11.
[90] *Id*. at 17-18.
[91] Columbia River Treaty, *supra* note 80, Art. XIX.
[92] *Id.*
[93] U.S. ARMY CORPS OF ENGINEERS AND BONNEVILLE POWER ADMIN., COLUMBIA RIVER TREATY: 2012/2024 REVIEW: PHASE 1 TECHNICAL STUDIES (Apr. 2009), *available at* http://www.bpa.gov/corporate/pubs/Columbia_River_Treaty_Review__2_-_April_2009.pdf.
[94] Columbia River Treaty, *supra* note 80, Art. IV.
[95] *See generally* Shurts, *supra* note 68.

examine what has changed since 1964 and where the uncertainties lie in contemplating basin needs after 2024.

III. CHANGE: 1964–2010 / DRIVERS OF CHANGE: 2010 FORWARD

The 2009 Columbia River symposium examined both change since 1964, and going forward in five categories: (1) change in values concerning the river; (2) change in empowerment of local communities and in particular, of Native American and First Nation governments; (3) change in the viability of populations of anadromous fish that spawn within the Columbia River system; (4) change in energy demand; and (5) climate change. This paper will briefly summarize some of the important points raised by participants in the Symposium, supplementing where appropriate from the literature, in each of these categories.

Change in values concerning the river: Two approaches to evaluating changes in values were used by participants in the Symposium: examination of the adoption of new laws reflecting a change in societal values concerning the environment; and a reconnaissance level survey of stakeholders in the basin done by students at the University of Montana.[96] The post-1964 law with the largest impact on operation of Columbia River dams on the U.S. side of the border is the Endangered Species Act adopted in 1973.[97] NOAA Fisheries (then National Marine Fisheries Service) began listing anadromous fish in the Columbia River system in 1991, and today eight salmon and four steelhead species that rely on habitat within the basin are listed.[98] Although numerous factors impact these species, operation of dams for hydropower has been identified as a major factor and operation of the Federal Columbia River Power System (the part of the hydropower system at federal dams in the U.S. portion of the basin), has been the subject of numerous Biological Opinions and subsequent challenges resulting recently in what some refer to as operation of the river by the federal district court.[99] Although the ESA and subsequent listings reflect a change in values and

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[96] *See generally* Matthew McKinney et al., *Managing Transboundary Natural Resources: An Assessment of the Need to Revise and Update the Columbia River Treaty, in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article on file with author).

[97] Endangered Species Act of 1973, 16 U.S.C. §§ 1531-1544 (2006).

[98] Current listings of salmon species found in the Columbia Basin: Snake River Sockeye (endangered), Upper Willamette River Chinook (threatened), Lower Columbia River Chinook (threatened), Upper Columbia River spring-run Chinook (endangered), Snake River fall-run Chinook (threatened), Snake River spring/summer-run Chinook (threatened), Lower Columbia River Coho (threatened), Columbia River Chum (threatened). Final Listing Determinations for 16 ESUs of West Coast Salmon, 70 Fed. Reg. 37160, 37193 (June 28, 2005). Note that four ESUs of steelhead are also currently listed: 69 Fed. Reg. 33105 (June 14, 2004) and 71 Fed. Reg 5178 (Feb. 1, 2006). However, these listings are currently in litigation. *See, e.g.,* Trout Unlimited v. Lohn, No. CV06-0483-JCC 2007 WL 1795036 (W.D. Wash. Jun 13, 2007), *aff'd in part, rev'd in part* 559 F.3d 946 (9th Cir. 2009); *see also* NOAA, Northwest Regional Office, ESA Salmon Listings, Salmon Populations, http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Index.cfm (last visited Apr. 5, 2010).

[99] *See, e.g.,* the many challenges to Biological Opinions issued by NOAA Fisheries (formerly National Marine Fisheries Service – NMFS) in 1993, 1995, 2000, and 2004: Idaho Dept. Fish and

provide a powerful lever for inclusion of issues concerning anadromous fish in any negotiation concerning operation of dams on the river, the current gridlock in the judicial system may be a further indication that the solution will come through a form of governance able to adapt to changing values rather than a lawsuit.

Environmental historians Paul Hirt[100] and Adam Sowards[101] looked at a more subtle yet pervasive change in laws that reflect a trend surely to impact any effort to update the Columbia River Treaty. Beginning with, or resulting in, the passage of the Freedom of Information Act in 1966,[102] and the National Environmental Policy Act in 1970,[103] the expectation of the public for access to and participation in governmental decision making began to increase dramatically in the United States.[104] As evidenced by contributions to the book to follow the Symposium by scholars studying implementation of the European Union Water Framework Directive,[105] this phenomenon is not confined to the United States.[106] This global demand for greater public input to natural resource decision making is also evidenced in the adoption of NEPA-like requirement in over eighty countries,[107] and the inclusion of public involvement requirements for water development projects funded by the World Bank.[108] As will be discussed below, utilization of this greater demand for participation can actually contribute to resilience in water resource governance.

A reconnaissance level situation assessment of stakeholders in the Columbia River basin done by students at the University of Montana under the direction of consortium member Dr. Matthew McKinney confirmed this expectation of public

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Game v. NMFS, 850 F. Supp. 886 (D. Or. Mar. 28, 1994); American Rivers v. National Marine Fisheries Service, CV 96-384-MA,1997 WL 33797790 (D. Or. Apr. 3, 1997); National Wildlife Federation v. National Marine Fisheries Service, 254 F. Supp. 2d 1196 (D. Or. 2003); National Wildlife Fund v. National Marine Fisheries Service CV 01-640-RE, 2005 WL 1278878 (D. Or. Oct. 7, 2005); National Wildlife Federation v. National Marine Fisheries Service, 422 F.3d 782 (9th Cir. 2005); National Wildlife Foundation v. National Marine Fisheries Service, CV 01-640 RE, 2005 WL 2488447 (D. OR.); NWF v. NMFS, 524 F.3d 917 (9th Cir. 2008).

[100] Arizona State University.

[101] University of Idaho.

[102] 5 U.S.C. §552 (2006).

[103] National Environmental Policy Act of 1969, Pub. L. No. 91-190, 83 Stat. 852 (1970) (current version at 42 U.S.C. § 4321 (2006)).

[104] Hirt & Sowards, *supra* note 71, at 20-21. While FOIA required governmental agencies to make public documents available to the public, 5 U.S.C. § 552 (2006), NEPA goes further by requiring agencies to actually develop the information necessary to evaluate the impact of a federal action on the human environment, provide that information to the public, and respond to public comment. 42 USC § 4332 (2006); 5 USC § 552 (2006).

[105] Council Directive 2000/60/EC, 2000 O.J. (L. 327) 1-73 (EC), *available at* http://ec.europa.eu/environment/water/water-framework/index_en.html.

[106] Lucia De Stefano & Guido Schmidt, *Public Participation and Water Management in the European Union: Experiences and Lessons Learned, in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article on file with author).

[107] ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY, 783 (Aspen Publishers, 4th ed. 2003).

[108] *See generally* WORLD BANK, WORLD DEVELOPMENT REPORT 2004: MAKING SERVICES WORK FOR POOR PEOPLE (2004).

input within the basin.[109] A situation assessment uses a defined list of questions and an initial list of major players with respect to the particular issues.[110] It then proceeds with a "snowball" sampling method which consists of ending each interview by asking who else the interviewer should speak to.[111] The interview process ends when no new information is being obtained.[112] In the context of the class used by Dr. McKinney to interview stakeholders in the Columbia River basin, this endpoint was not reached. Twenty-seven people were interviewed on both sides of the international border and the final recommendations included that the assessment must be expanded.[113] The initial assessment nevertheless identified several key perceptions. First, if measured by the 1964 goal of flood protection and increased power production, the Columbia River Treaty has been an outstanding success.[114] Second, among the key issues identified by stakeholders that were not addressed in 1964, but should be in the future, the health of the salmon fishery, and participation by affected communities, Native American tribes and First Nations, stood out as themes repeated by many interviewees.[115] This perception is paralleled by the dramatic change in empowerment among basin communities addressed next.

Changes in empowerment of local communities and in particular, of Native American and First Nation governments: As discussed in Part II, local participation in knowledge generation and decision making is an important factor for resilience in governance involving ecological systems. However, this participation has led to enhanced empowerment and capacity of basin communities, suggesting that they have the capacity to participate and are likely to demand participation in any decision on whether to and how to modify the Treaty: (1) legal recognition of the treaty rights of certain Native American tribes to participate in the harvest and management of Columbia basin fisheries within the United States; (2) establishment of the Northwest Power and Conservation Council in the United States in 1980; (3) Constitutional recognition of the rights of First Nations in Canada in 1982; and (4) legislative recognition of the Columbia Basin Trust in Canada in 1995. This increased local and regional capacity will be an important component of moving toward resilience in governance discussed below. To begin, it is important to understand these changes.

First, among the rights secured by certain Columbia basin tribes south of the 49th Parallel at the council of Walla Walla in 1855, is the right to continue to use

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109 McKinney et al., *supra* note 96, at 5.

110 Lawrence Susskind & Jennifer Thomas-Larmer, *Conducting a Conflict Assessment*, *in* THE CONSENSUS BUILDING HANDBOOK: A COMPREHENSIVE GUIDE TO REACHING AGREEMENT, 99, 108-113 (Lawrence Susskind et al. eds., 1999).

111 *Id.* at 114.

112 *Id.*

113 McKinney et al., *supra* note 96, at 20.

114 *Id.* at 17.

115 *Id.* at 19.

their former fishing grounds on lands outside the newly designated reservations.[116] For example, Article 3 of the Nez Perce Treaty reserves: "[t]he exclusive right of taking fish in all the streams where running through or bordering said reservation is further secured to said Indians; as also the right of taking fish at all usual and accustomed places in common with citizens of the Territory."[117] The language stating that the right is "in common with citizens of the Territory," was interpreted by Judge Boldt of the U.S. District Court, Washington in 1974, to entitle treaty tribes to up to 50% of the harvestable fish that pass (or would pass absent harvest en route[118]) the usual and accustomed fishing places.[119] At the time of the council in 1855, non-Indian fishing in the area was minor;[120] however, once canneries made large scale commercial fishing possible,[121] non-Indian harvest began to present major competition for the fish. However, the ruling recognizing the legal right of Native American's equal access to fish would not come until over a decade after the Columbia River Treaty was finalized. In affirming the District Court, the Ninth Circuit Court of Appeals interpreted the right of treaty tribes "in common with citizens of the Territory," as analogous to a co-tenancy, stating:

> [C]otenants stand in a fiduciary relationship one to the other. Each has the right to full enjoyment of the property, but must use it as a reasonable property owner. A cotenant is liable for waste if he destroys the property or abuses it so as to permanently impair its value . . . By analogy, neither the treaty Indians nor the state on behalf of its citizens may permit the subject matter of these treaties to be destroyed.[122]

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[116] *See generally* ALVIN M. JOSEPHY, JR., THE NEZ PERCE INDIANS AND THE OPENING OF THE NORTHWEST, 292-332 (1965) (speaking to the importance of maintaining traditional fisheries in treaty negotiation).

[117] Treaty between the United States of America and the Nez Perce Indians, art. III, June 11, 1855 12 Stat. 957. During 1854 and 1855, Stevens negotiated treaties with 11 northwest tribes. United States v. Washington (*Boldt Decision),* 384 F. Supp. 312, 330 (W. D. Wash. 1974) *aff;d* 525 F.2d. 676 (9th Cir. 1975), *cert. denied,* 423 U.S. 1086 (1975) (affirming treaty fishing rights associated with this treaty language). For accounts of the gathering of the northwest Tribes on Mill Creek in the Walla Walla Valley and the negotiations with Governor Stevens, see JOSEPHY, *supra* note 116. *See also Boldt Decision*, 384 F. Supp. at 355 ("At the treaty negotiations, a primary concern of the Indians whose way of life was so heavily dependent upon harvesting anadromous fish, was that they have freedom to move about to gather food, particularly salmon, (which both Indians and non-Indians meant to include steelhead), at their usual and accustomed fishing places.").

[118] *Boldt Decision,* 384 F. Supp. at 344.

[119] *Id.* at 343; *see also* Washington v. Washington State Commercial Passenger Fishing Vessel Ass. 443 U.S. 658, 685 (1979) (responding to litigation involving implementation of the *Boldt* decision, the Court stated: "[A]n equitable measure of the common right should initially divide the harvestable portion of each run that passes through a 'usual and accustomed' place into approximately equal treaty and nontreaty shares, and should then reduce the Treaty share if tribal needs may be satisfied by a lesser amount.").

[120] *Boldt Decision,* 384 F. at 352.

[121] *Id. See also* Wash. State Commercial Passenger Fishing Vessel Ass'n., 443 U.S. at 668 ("Not until major economic developments in canning and processing occurred in the last few years of the 19th century did a significant non-Indian fishery develop.").

[122] United States v. Washington, 520 F.2d 676, 685 (9th Cir. 1975).

In the wake of these decisions the four tribal governments implicated, the Nez Perce, Confederated Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, and Confederated Tribes of the Warm Springs Reservation, formed the Columbia River Intertribal Fish Commission ("CRITFC") in 1977 to unite the efforts of the four tribal governments to renew their sovereign authority in fisheries management.[123] This legal recognition of rights combined with the capacity building reflected in the scientific and policy work of CRITFC, has elevated the status of the four tribes to co-managers of salmon in the U.S. portion of the Columbia River basin.

In addition to the tribes participating in CRITFC, the five upper Columbia tribes in the United States have joined together on various resource issues of common concern forming the Upper Columbia United Tribes ("UCUT").[124] The primary common issue among the Coeur d'Alene Tribe, the Kalispel Tribe of Indians, the Spokane Tribe of Indians, the Kootenai Tribe of Idaho, and the Confederated Tribe of the Colville Reservation is the blockage of their lands from anadromous fish migration by Grand Coulee Dam.[125] In 2005 UCUT and its member tribes entered a memorandum of understanding with Bonneville Power Administration recognizing the sovereign role of the tribes in management of, among other things, fish and water resources.[126]

Second, the Northwest Power Act of 1980,[127] built local and regional capacity to participate in decision making about the management of the Colombia River. The Act is an interstate compact approved by the legislatures of Idaho, Montana, Oregon, and Washington and by Congress to give the four states a greater role in decision making with respect to electric power and fish and wildlife in the Columbia River basin.[128] The resulting Northwest Power and Conservation Council ("Council") is made up of two political appointees from each state, has legal and technical staff, and is funded through power revenues from Bonneville Power Administration.[129] The Council has three primary objectives:

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[123] Columbia River Intertribal Fish Commission, http://www.critfc.org/text/work.html (last visited Mar. 18, 2010).

[124] *See* Upper Columbia United Tribes, http://www.ucut.org/index.ydev (last visited on Mar. 18, 2010).

[125] Upper Columbia United Tribes, Programs, In the Field, http://www.ucut.org/in_the_field.ydev#news_paragraph6 (last visited Mar. 18, 2010).

[126] *Id.*

[127] Pacific Northwest Electric Power Planning and Conservation Act, (Northwest Power Act), Pub. L. No. 96-501, 94 Stat. 2697. From the preamble to the Act: "To assist the electrical consumers of the Pacific Northwest through use of the Federal Columbia River Power System to achieve cost-effective energy conservation, to encourage the development of renewable energy resources, to establish a representative regional power planning process, to assure the region of an efficient and adequate power supply, and for other purposes." *Id.*

[128] *See* Northwest Power and Conservation Council, http://www.nwcouncil.org/Default.htm (last visited Mar. 2, 2010).

[129] *Id.*

> 1. develop a 20-year electric power plan that will guarantee adequate and reliable energy at the lowest economic and environmental cost to the Northwest
> 2. develop a program to protect and rebuild fish and wildlife populations affected by hydropower development in the Columbia River Basin
> 3. educate and involve the public in the Council's decision-making processes. [130]

The Act requires all actions of Bonneville Power Administration ("BPA") to be consistent with the Council's electric power plan.[131] In contrast, the fish and wildlife program is intended to be based on input from states, tribes and federal agencies, and to complement their activities, but it is not the role of the Council or BPA to reconcile the fish and wildlife program with hydropower operations in the basin.[132] As part of its efforts to develop a fish and wildlife program and to involve the public, the Council undertook a sub-basin planning process completed in 2005, to identify and prioritize habitat restoration opportunities.[133] The Council's positive efforts to involve the public in habitat restoration decisions, juxtaposed with the absence of any connection between these efforts and BPA decisions on power, have led to an informed but frustrated public.[134] The Council has no formal role associated with the Columbia River Treaty. The fact that the entity which must generate hydropower consistent with the Council's energy plan and one of the U.S. entities appointed to operate the Treaty are the same, BPA, merely provides an informal means of communication and coordination but not one that *must* be utilized. The Council has no direct role in treaty implementation or any decision to modify the Treaty, but its formation and efforts to involve and educate the public signal an increase in capacity within the basin to seek a role in the decision making process.

Neither CRITFC nor the Council should be viewed as providing a unified voice in treaty decisions for their respective members. Upstream and downstream tribes and states frequently have conflicting interests.[135] Nevertheless, these organizations have greatly increased the knowledge and capacity of their members to weigh in on Treaty issues. This capacity did not exist in 1964.

Third, the capacity of First Nations to participate in decision making has also increased in the Canadian portion of the basin. For example, Britain granted

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[130] *Id.*

[131] Northwest Power Act § 839b(d)(2).

[132] *Id.* § 839b(h).

[133] Northwest Power and Conservation Council, *supra* note 128. The process resulted in restoration plans for 58 tributary watersheds and mainstem segments. *Id.*

[134] *See, e.g.,* MICHAEL BLUMM, SACRIFICING THE SALMON: A LEGAL AND POLICY HISTORY OF THE DECLINE OF COLUMBIA BASIN SALMON (2002).

[135] *See, e.g.,* Press Release, Columbia River Inter-Tribal Fish Commission, CRITFC, The Accords, The Biological Opinions (Sept. 2009), *available at* http://www.critfc.org/text/press/2009 0930.html. *See also* BONNEVILLE POWER ADMINISTRATION, ADMINISTRATOR'S RECORD OF DECISION 2008 COLUMBIA BASIN FISH ACCORDS (2008), *available at* http://www.salmonrecovery.gov/Files/ BiologicalOpinions/MOA_ROD.pdf.

Canada full sovereignty in 1982, when the Canadian Constitution was patriated,[136] and the Constitution Act of 1982 recognized aboriginal and treaty rights, including rights acquired through land claim agreements, of aboriginal people in Canada.[137] This formal constitutional recognition is expected to elevate the status of First Nations in providing input on any decision by Canada regarding the Treaty. [138]

Fourth, the Columbia Basin Trust ("the Trust")[139] has become a major player on the Canadian side of the basin. Its formation is described on its website:

> Despite the significant changes that occurred across the Columbia Basin as a result of the Treaty, there was a lack of consultation with residents. The people of the Basin came together in the early 1990s to press the Province of BC for recognition of the injustice of this situation. Local governments coordinated their efforts (at the regional district and tribal council levels and in partnership with elected officials) under the formation of the Columbia River Treaty Committee, in order to approach and negotiate with the Province.
>
> Negotiations were successful and, in 1995, Columbia Basin Trust was established. A binding agreement was also established which resulted in the following for the residents of the Basin through Columbia Basin Trust:
>
> - $276 million to finance power project construction;
> - $45 million, with CBT used as an endowment; and
> - $2 million per year from 1996 to 2010 for operations.[140]

The Trust has participation from First Nations and other communities in the Columbia River basin in Canada. The recognition of the Trust by the Province of British Columbia in 1995, and the knowledge and capacity built by the Trust through its substantial funding, suggests that the people of the basin in Canada will not be excluded from future treaty decisions. The involvement of the Trust in hydropower development and partial funding through sale of the Canadian Entitlement also suggests that its input may be more nuanced than its roots in seeking redress from harms caused by implementation of the Treaty would suggest.

Changes in the viability of populations of anadromous fish that spawn within the Columbia River system: The decline of anadromous fish in the Columbia River system has been extensively documented, thus it will be briefly addressed here. It is important to note that the blockage of migration from Canada

[136] Patriation of Canada's constitution was the process of eliminating the need for an act of the British Parliament to amend the constitution and thus the acquisition of full sovereignty for Canada.

[137] Constitution Act, 1982, pt. II, sec. 35 (1982), *available at* http://www.solon.org/Constitutions/Canada/English/ca_1982.html.

[138] Garry Merkel, *The Columbia River and First Nations, in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft forward on file with author).

[139] *See* The Columbia Basin Trust, About Us, http://www.cbt.org/ (last visited Mar. 18, 2010).

[140] *Id.*

and the reservations of certain upper Columbia River Native American tribes was a *fate accompli* by the time of the 1964 Columbia River Treaty. The completion of Grand Coulee Dam in 1942 accomplished this task.

However, the impact of the elimination of habitat by the construction of Grand Coulee Dam will be important in any discussion of the resilience of the anadromous fish populations in the basin. In the remaining portion of the basin, salmon declined from an estimated high of 6 to 16 million in the early 1880s to less than 1 million today.[141] The salmon fishery in the Columbia River basin is now supported by 200 hatcheries.[142] Ongoing litigation[143] concerning operation of the federal dams and salmon recovery, points to relative gridlock between the two competing values. It is difficult to argue that these changes were not foreseen,[144] but it is clear that the solution chosen, hatcheries, may not be the answer.

One caution raised at the Symposium is important to note: "'It is uncertain whether degraded salmon ecosystems remain sufficiently resilient to respond positively to ongoing restoration programs, or have shifted to a stable, low-productivity state that may persist regardless of the climatic regime.'"[145] Under the definition of resilience: "[t]he amount of disturbance an *ecosystem* can accommodate without shifting to a fundamentally different structure, function and feedback mechanisms . . . ,"[146] it is possible that we have so altered the ecological system of the Columbia River that salmon restoration in any way resembling a natural system is impossible, creative governance notwithstanding.

In a recent special 2009 issue from Ecology and Society on *Pathways to Resilient Salmon Ecosystems*,[147] scientists explored the prospects for Pacific salmon, including Columbia River populations. In contrast to the single population of Atlantic salmon, Pacific salmon have adapted to a relatively dynamic geologic coastline and riverine environment of the west coast through the development of

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[141] Chris Peery, *The Effects of Dams and Flow Management on Columbia River Ecosystem Processes*, *in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article at 2, on file with author).

[142] *Id.*

[143] *See* cases cited *supra* note 99.

[144] Daniel Bottom et al., *Reconnecting Social And Ecological Resilience in Salmon Ecosystems*, 14(1) ECOLOGY AND SOCIETY 5 (SPECIAL ISSUE) 1 (2009), *available at* http://www.ecologyandsociety.org/vol14/iss1/art5/ (PDF link at top of page)

> In an open letter to the Oregon State legislature in 1875, U.S. Commissioner of Fish and Fisheries Spencer Baird painted a grim future for Pacific salmon (*Oncorhynchus* spp.) in the Columbia River (Baird 1875). Based on the collapse of Atlantic salmon (*Salmo salar*) in Northeast American rivers decades earlier, Baird predicted that Columbia River salmon would suffer a similar fate for the same reasons: habitat loss, excessive harvest, and dams and other impediments to fish migration.

[145] Thomas M. Leschine, *Salmon Fisheries on the Columbia from a Resilience Perspective: Past, Present and Future*, *in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft at 15, on file with author) (quoting Bottom et al., *supra* note 144, at ABSTRACT).

[146] *Id. See also* Bottom et al., *supra* note 144, at Abstract.

[147] *Pathways to Resilient Salmon*, 14(1) ECOLOGY AND SOCIETY (SPECIAL ISSUE) (2009), http://www.ecologyandsociety.org/issues/view.php?sf=34 (last visited Mar. 19, 2010).

multiple locally adapted populations.[148] The 10 million year survival of Pacific salmon in the face of a highly dynamic coastal environment is a tribute to their resilience.[149] However, anthropogenic changes have occurred on both a scale and timeframe that does not match historic variability in the system.[150] Thus, key to restoring salmon resilience is not merely to maintain genetic diversity through hatcheries, but to re-establish the natural processes that led to adaptation.[151] Because salmon have the audacity to use the entire length of a river system as well as the ocean to complete their life cycle, this requires a daunting level of cross-jurisdictional coordination.[152]

Changes in energy demand: Energy demand and development has not proceeded as contemplated by the Treaty drafters in 1964. At that time, planners expected the rapid growth in power demand that followed World War II to continue.[153] This would mean that new thermal generation would have to rapidly replace hydropower as the dominant source of energy in the Pacific Northwest.[154] Conservation nation-wide in the wake of the 1970's energy crisis altered this picture, but not before the commitment of major expenditures on development of nuclear power had been made in the Pacific Northwest. The major overestimate of demand and underestimate of the cost of nuclear power plants led to a debacle the region is not anxious to repeat and the plants were not completed.[155] As a result, hydropower remains the dominant energy source in the region[156] and the value of the system has grown dramatically. With the current push to develop non-carbon sources of energy, hydropower is likely to become even more valuable. The recent draft power plan released in September 2009 by the NWPCC indicates that "the most cost effective and least risky resource for the region" to meet electricity demand over the next twenty years "is improved efficiency of electricity use."[157] If

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[148] *See* Robin S. Waples, *Evolutionary History, Habitat Disturbance Regimes, and Anthropogenic Changes: What Do These Mean for Resilience of Pacific Salmon Populations?*, 14(1) ECOLOGY AND SOCIETY (SPECIAL ISSUE) 3, 10 (2009), *available at* http://www.ecologyandsociety.org /vol14/iss1/art3/ (PDF link at top of page).

[149] Michael C. Healey, *Resilient Salmon, Resilient Fisheries for British Columbia, Canada*, 14(1) ECOLOGY AND SOCIETY (SPECIAL ISSUE) 2, 5 (2009), *available at* http://www.ecologyandsociety .org/vol14/iss1/art2/ (PDF link at top of page).

[150] *Id.* at 1.

[151] *Id.* at 6.

[152] *See generally* Bottom et al., *supra* note 144 (article premise focuses on the necessary elements for cross-jurisdictional coordination).

[153] Shurts, *supra* note 68, at 19.

[154] *Id.*

[155] WHITE, *supra* note 2, at 79. "This effort by the Washington Public Power Supply System (WPPSS referred to as 'Whoops') to build 5 nuclear power plants, ran over budget and head on to electric demand far below protections. Construction of the last two reactors was abandoned and only one of the first three reactors ever produced electricity." *Id.* at 79-80.

[156] Hirt & Sowards, *supra* note 71, at 31 (noting that 60 percent of the region's power supply comes from hydropower).

[157] NORTHWEST POWER AND CONSERVATION COUNCIL, DRAFT SIXTH NORTHWEST POWER PLAN, PLAN OVERVIEW 1-2 (Feb. 2010), *available at* http://www.nwcouncil.org/energy/powerplan/6/final/ Ch1_021010.pdf.

this projection proves true, it is likely hydropower will remain at the core of northwest energy production through any near-term scenarios.

Climate change: Water planners have long relied on data from a historic period of record to project water supply into the future. It is the seasonal variation, and the year-to-year variation that can be forecast within the degrees of historical variability, that the type of agency (or "entity") level operational planning envisioned by the 1964 Columbia River Treaty handles well. Under the Treaty, the entities must develop two levels of operating plans. First, an advanced planning stage results in an Assured Operating Plan ("AOP") each year for six years in advance.[158] This allows planning for such things as new power generation.[159] Second, the Detailed Operating Plan ("DOP") is prepared each year for the following year to update the AOP and to provide more details on operations.[160] Third, the Treaty Storage Regulation ("TSR") study is done during the actual operating year and is based on both the DOP and current conditions, and defines storage and draft requirements for treaty reservoirs.[161] Finally, Supplemental Operating Agreements ("SOA") may be used to vary from the TSR if mutual benefits in power, flood control fisheries, or other values may be achieved.[162] In this way, the Treaty provides sufficient flexibility for adaptive management to account for seasonal and year-to-year uncertainty within the limited purposes of the Treaty.

Climate change takes us out of the range of variation that can be predicted based on historic behavior.[163] Most current discussion on climate change focuses on reducing emissions of greenhouse gases.[164] This is an important goal. However, due to the lag in impact, even the most aggressive efforts at reduction in emissions will not prevent continued impact for the foreseeable future.[165] Climate experts recommend planning for adaptation through use of scenarios that represent a range of possible futures, rather than projections based on historic behavior of a system.[166] Thus, given the range of potential temperature and precipitation changes, governance that is adaptive to climate change must include authorization

[158] Barton & Ketchum, *supra* note 67, at 6.
[159] *Id.*
[160] *Id.*
[161] *Id.*
[162] *Id.*
[163] Hamlet, *supra* note 69, at 16-20.
[164] *See, e.g.,* UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, THE COPENHAGEN ACCORD (2009), *available at* http://unfccc.int/files/meetings/cop_15/application/pdf/ cop15_cph_auv.pdf (the Accord includes some language on adaptation.). For general information on the United Nations Climate Change Conference of 2009, see Denmark, Climate and Energy, COP 15, Copenhagen 2009, http://www.denmark.dk/en/menu/Climate-Energy/COP15-Copenhagen-2009/ (last visited Mar. 18. 2010).
[165] *See generally* Susan Solomon et al., *Irreversible Climate Change Due to Carbon Dioxide Emissions*, *in* 106 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES 1704 (2009), *available at* http://www.pnas.org/content/106/6/1704.full.pdf+html.
[166] *See generally id.* (discussing the impact of climate change on traditional models).

that allows managers to respond to actual outcomes ranging from the best case to the worst case scenario.[167]

Modeling by the Climate Impacts Group suggests that precipitation may not change dramatically within the Columbia River basin, albeit substantial uncertainty is associated with this statement.[168] However, changes in annual snowpack can be predicted with greater certainty and are already underway in the basin.[169] The basin relies on snowpack as natural storage that, similar to reservoirs, moderates summer flows. With climate change, reduction in snow-water equivalent may be as much as 35% in the U.S. portion of the basin by 2060 and 12% in the Canadian portion of the basin.[170] This reduction in natural storage means that the artificial storage configuration in the basin will be insufficient to reap the power benefits available in the past.[171] In particular, summer production which serves utilities in the southwestern U.S. will decrease if the current configuration is maintained.[172]

Moving out of the historic water supply regime has impacts beyond power production. The Columbia River Treaty provides an excellent framework to address high flow. However, it does not address low flow under a climate change scenario.[173] Adaptation to climate change for other uses such as irrigation and fisheries requires response by multiple agencies in the U.S. with no framework for coordination.[174] Irrigation occurs during the summer season when the lowest flows will occur if storage is insufficient. The result of failure to address low flows: fish and farmers will bear the brunt of climate change if no effort is made to adapt.[175]

IV. IMPLEMENTING RESILIENCE THROUGH ADMINISTRATIVE LAW

The call for change in governance to address the failures of multi-jurisdictional management of natural resources is not a new concept.[176] Efforts by legal scholars to address the issue of management of complex, multi-jurisdictional ecological systems tends to take a case study approach involving identification of good multi-jurisdictional management when we see it, then attempting to draw lessons related to why the particular approach worked that might be transferrable

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[167] Hamlet, *supra* note 69, at 16-20.

[168] *Id.*

[169] *Id.* at 16-20; Anne Nolin, Eric Sproles, & Aimee Brown, *Climate Change Impacts on Snow and Water Resources in the Columbia, Willamette, and McKenzie River Basins, USA: A Nested Watershed Study*, *in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article on file with author).

[170] *Id.*

[171] Hamlet, *supra* note 69, at 16-20.

[172] *Id.*

[173] *Id.*

[174] *Id.*

[175] *Id*.

[176] *See, e.g*., Jody Freeman & Daniel A. Farber, *Modular Environmental Regulation*, 54 DUKE L.J. 795 (2005); GLOBAL WATER PARTNERSHIP, TAC BACKGROUND PAPERS, No. 4: INTEGRATED WATER RESOURCES MANAGEMENT, 67 (2000) *available at* www.gwpforum.org/gwp/library/Tacno4.pdf; *see* Ruhl & Salzman, *supra* note 54 (discussing solutions to problems associated with the environmental administrative state).

to other settings.[177] The value of using case studies is the grounding of scholarly effort in real world experience. Particularly in the realm of complex systems, initial efforts at research must be empirically based. This research seeks to add to that literature by viewing governance through the lens of resilience theory and thus providing a transferrable framework for modifications to administrative law.[178] This paper has set forth the theoretical basis for resilient or adaptive governance. In the following paragraphs, an attempt will be made to translate that theoretical basis into a framework for an administrative response and will use its application to the Columbia River basin for grounding in reality. Ongoing research at the University of Idaho College of Law and interdisciplinary Waters of the West Program is seeking to translate the framework into a specific model or models for administrative law and is planned to be reported in a future paper.

The following list identifies the elements of the administrative law or process aspects of adaptive governance to facilitate resilience in social-ecological systems. The list is followed by a discussion of each element and its application to the Columbia River basin:

- Multiple, overlapping levels of control with one level of either control or strong coordination at the scale of the particular social-ecological system;
- Horizontal and vertical transfer of information and coordination of decision-making among entities and individuals with a decision making role;
- Meaningful public participation;
- Local capacity building; and
- Authority to respond (adapt) to changes in circumstances across a range of scenarios.

Each of these elements will be discussed in turn, however it is worth noting that in addition to these process elements, facilitation of resilience in social-ecological systems will also require changes in substantive environmental and natural resources laws by incorporating a bias for decision making that enhances resilience rather than optimization. Thus, when faced with two possible choices, the approach that fosters ecological system resilience is chosen. For example, hatchery design to more closely mimic natural conditions (an approach currently being attempted by the Nez Perce Tribe in an experimental hatchery),[179] would be chosen over traditional fish hatchery design to optimize fish numbers; or the use of spill from dams to mimic natural conditions would be chosen over the use of

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[177] *See, e.g.*, Freeman & Farber, *supra* note 176 (using the CalFed process for management of the California Bay-Delta system as what, at the time, appeared to be a good example of formal establishment of a multi-agency multi-level governance network); Ruhl & Salzman, *supra* note 54, at 46-48 (describing the weak networks of the Gulf Hypoxia Task Force as an effective means to address a large-scale, complex environmental problem across multiple jurisdictions and levels of government); Zellmer & Gunderson, *supra* note 50 (looking at the application of adaptive management to the Everglades and Grand Canyon).

[178] *See* Ruhl & Salzman, *supra* note 54, at 41-45 (drawing on several theories of governance including Dynamic Federalism, New Governance, and Transgovernmental Network theories).

[179] *See* Nez Perce Tribal Hatchery, http://www.nezperce.org/~dfrm/Production/npth.html (last visited Apr. 6, 2010).

tanker trucks to move smolts around dams.[180] This movement of the substance of natural resource management—from optimization to resilience, and from command and control to adaptive management—is beyond the scope of this paper, but it is being actively explored by much of the research cited above and in legal scholarship.[181] This paper will focus on the following process elements.

Multiple, overlapping levels of control with one level of either control or strong coordination at the scale of the particular social-ecological system: Matching the scale of governance to the scale of the problem has gained traction in legal scholarship.[182] However, as noted by Ruhl and Salzman, complex systems do not always have clearly identifiable scales for governance.[183] A scale that may be appropriate for one problem is not relevant for another.[184] Complicating the scale issue even more is the fact that the source of the problem and the negative impact may occur at different scales thus removing any incentive for action at the scale of the source of the problem.[185] We have seen this in the form of backlash to some of the environmental laws passed in the 1970s. For example, the failure of states to take action led to federal regulation to achieve clean water,[186] clean air,[187] and species protection.[188] Yet matching the scale of regulation to the scale of the problem did nothing to convince local land use planning to address non-point source pollution (important to downstream water quality),[189] or persuade local developers to support the changes required to protect wetlands (important to

[180] *See, e.g.*, Columbia River History, Fish Transportation, Northwest Power and Conservation Council, http://www.nwcouncil.org/history/FishTransportation.asp (last visited Apr. 6, 2010).

[181] *See, e.g.*, Zellmer & Gunderson, *supra* note 50; Sandra Zellmer, *Floods, Famines, or Feasts: Too Much, Too Little, or Just Right*, 24(3) NR&E 20 (Winter 2010).

[182] *See, e.g.*, Ruhl & Salzman, *supra* note 54, at 10 (citing Henry N. Butler & Jonathan R. Macey, *Externalities and the Matching Principle: The Case for Reallocating Environmental Regulatory Authority*, 14 YALE L. & POL'Y. REV. 23 (1996)).

[183] Ruhl & Salzman, *supra* note 54.

[184] *Id.*

[185] *See, e.g.*, Jerrold Long, *From Warranted to Valuable Belief: Local Government, Climate Change, and Giving Up the Pickup to Save Bangladesh*, 50 NAT. RESOURCES J. (forthcoming Apr. 2010) (arguing that the difference in scale between global climate change and the source of a significant portion of the problem in individual and local land use planning choices on issues like transportation removes the incentive to take action.).

[186] Federal Water Pollution Control Act (Clean Water Act), 33 U.S.C. §§ 1251-1387 (2006).

[187] Clean Air Act (CAA), 42 U.S.C. §§ 7401-7671q (2006).

[188] Endangered Species Act (ESA), 16 U.S.C. §§ 1531-1544 (2006).

[189] *See, e.g.*, ROBERT W. ADLER, JESSICA C. LANDMAN, & DIANE M. CAMERON, THE CLEAN WATER ACT 20 YEARS LATER (1993).

filtration of polluted water and flood mitigation on a larger scale),[190] or an obscure species (important to biodiversity in general).[191]

As discussed in Part III, in contrast to the difficult search for the appropriate match in scale, resilience thinking rejects the call for a single, efficient level of management and instead calls for multiple overlapping authority. This approach then allows response at different scales across different entities depending on the source and impacts of the problem. Ruhl and Salzman provide an overview of the literature on Dynamic Federalism, which calls for dual and overlapping federal and state authority to allow an evolving response to the change in scale of a problem and an increased likelihood that system response to anthropogenic activity will be detected at multiple scales.[192] In addition to its inclusion of any level of governance and non-governmental local action, resilience thinking adds to this the concept of assuring that coordination must at least occur at the scale of the social-ecological system involved.

Governance within the Columbia River Basin follows the traditional approach with little local input, role, or exchange in international and national operations. Flood control is managed at the macro level through storage operation, with no local role for maintaining the connection between the river and the floodplain or regulating development out of the floodplain. Nevertheless, as noted by Eve Vogel, a contributor to the forthcoming Symposium volume, it is the Columbia River Treaty, entered by two governments functioning at a scale much larger than the river basin that allowed regionalization of the management of the entire Columbia mainstem across numerous states and an international boundary.[193] Thus, given the jurisdictional boundaries, governance of the river basin may require inclusion of government at a larger scale to achieve coordination on the scales of a social-ecological system.

Looking further to the passage of the Northwest Power Act in 1980, which provided both a role for states in power planning and a means to coordinate, as well as a means for local capacity building on the issue of habitat restoration, it did not provide a state or local say in whether power production should be optimized

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190 *See, e.g.*, Rapanos v. United States, 547 U.S. 715 (2006) (holding: (1) term "navigable waters," under CWA, includes only relatively permanent, standing or flowing bodies of water, not intermittent or ephemeral flows of water; and (2) only those wetlands with a continuous surface connection to bodies that are waters of the United States in their own right are adjacent to such waters and covered by the CWA); Barbara Cosens, *Resolving Conflict in Non-Ideal, Complex Systems: Solutions for the Law-Science Breakdown in Environmental and Natural Resource Law*, 48 NAT. RESOURCES J., 257 (2008).

191 National Ass'n of Home Builders v. Babbitt, 130 F.3d 1041, 1059 (D.C. Cir. 1997), *cert. denied* 524 U.S. 927 (1998) (holding the listing of a species under the Endangered Species Act when the species is found within a small range entirely within a single state is an appropriate exercise of federal authority under the commerce clause due to the impact in decline in biodiversity on interstate commerce).

192 Ruhl & Salzman, *supra* note 54, at 47.

193 *See generally* Eve Vogel, *Regionalization and Democratization Through International Law: Intertwined Jurisdictions, Scales and Politics in the Columbia River Treaty, in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft manuscript, on file with author).

over all other ecosystem services from the river. That decision remains static in the choice of hydropower and flood control as the primary international goals.

If the parties to the Columbia River Treaty seek a more resilient form of river governance, it will require a change in the operations implementation of the Treaty to allow more flexible response at the international level and greater local input at the level of operational decisions. The entities necessary to provide multiple, overlapping authority now exist in the Columbia River basin, but it is their input to the Treaty and operational decisions and their role in implementation that would need to change. The coordination required for this greater degree of adaptive capacity across and between levels of authority will require both sharing of information and coordination of decision-making.

Horizontal and vertical transfer of information and coordination of decision-making among entities and individuals with a decision-making role: As we have seen in recent years with the formation of the Department of Homeland Security in an effort to coordinate our various intelligence gathering agencies, sharing of information is crucial to reducing uncertainty when problems occur and are caused at multiple scales and from diverse sources. Yet, while the single-entity, high-level coordination of information may be well suited to reducing uncertainty, it is less suitable for an appropriate response to the incident that inevitably occurs because uncertainty in areas like terrorism or climate change can never be reduced to zero. Instead, as is asserted above that the appropriate, or resilient, response requires multiple levels of authority, including the local level. The weakness in responding to either a sudden or slow incident through multiple entities is the inability to coordinate decision-making and information exchange across jurisdictional boundaries.

However, an excellent example of a proven and highly robust system for overcoming this weakness is presented to the general public on national news on an annual, if not more frequent basis. The example is the incident command system for multi-jurisdictional response to a large-scale, often mass casualty, emergency. The incident command system is a highly robust process for multi-entity response to an emergency, in which the scale and timing was highly uncertain prior to its occurrence.[194] Rather than create a new agency at the scale of every conceivable emergency, the incident command system provides a means for rapid crisis response across multiple agencies at the same level and through multiple levels of agencies. The system works on the rule of sevens. The incident commander is at the top level of response. No more than seven people or entities report to the incident commander, no more than seven to each of those seven, etc., until the on-the-ground response to, for example, a wildfire, a flood, or an earthquake, may involve hundreds or even thousands of people. In the author's

[194] *See, e.g.,* THE U.S. DEPARTMENT OF HOMELAND SECURITY, NATIONAL INCIDENT MANAGEMENT SYSTEM: FREQUENTLY ASKED QUESTIONS, *available at* http://www.fema.gov/pdf/emergency/nims/NIMSFAQs.pdf; U.S. Forest Service, International Programs, Disaster Mitigation Program, http://www.fs.fed.us/global/aboutus/dmp/welcome.htm (last visited Mar. 18, 2010) (please note, the author has personal experience with this system responding to wild-land fires as a former volunteer with Lewis and Clark County, Montana, Search and Rescue).

experience, the initial hours or even days of response to a large scale emergency are often chaotic as response personnel move into position, assess the scope of the problem and identify the chain of command. However, within a remarkably short period of time, given the level of uncertainty involved, a relatively smooth operation emerges in which information and coordination of decisions in response to changes in the problem flow rapidly within and between levels.

Other than a flood event, the types of change and uncertainty in the Columbia River basin are not on the time scale of an emergency. Nevertheless, we can take a least three lessons from the incident command system. First, coordination and communication among different entities works better if it is an express requirement and assigned position within each entity. Second, practice improves response. Under the incident command system, the operation appears to be much smoother in response to incidents, such as wildfire, that occur somewhat predictably on an annual time scale, than it is in response to rare events, such as a hurricane or earthquake. In the context of Columbia River management, this could translate into frequent information sharing among entities as a building block in the relationships necessary for multi-jurisdictional decision making. The current high level of coordination among the operating entities is an excellent model for this process. Third, substantial resources must be devoted to the local level. The current structure of resource availability, both with respect to funding and people, for entities that manage natural resources may need to be inverted, with greater resources made available at the local rather than national level. This will be discussed further under local capacity building.

However, mandating the flow of information and coordination among jurisdictions is not likely to be enough. In their work on adaptive governance, Folke et al. note that success in managing ecological systems for resilience often depends on the involvement of key personality types such as mavens ("altruistic individuals, with social skills, who serve as information brokers, sharing and trading what they know"),[195] connectors ("individuals who know lots of people not only by numbers but the kind of people they know and in particular the diversity of acquaintances"),[196] and entrepreneurial leaders (creative decision makers willing to risk being the first to try something).[197] This is consistent with the author's experience in multi-jurisdictional water negotiations in which success is often determined by key personalities involved.[198] It is also reflected in the reliance of Ruhl and Salzman on Transgovernmental Network theory in which "weak ties" are formed among individuals working at various levels of governance and non-

[195] Folke et al., *supra* note 44, at 454 (quoting Malcolm Gladwell, THE TIPPING POINT: HOW LITTLE THINGS CAN MAKE A BIG DIFFERENCE (2000)).

[196] *Id.*

[197] *Id.* at 451.

[198] *See, e.g.*, Barbara Cosens, *The 1997 Water Rights Settlement Between the State of Montana and the Chippewa Cree Tribe of the Rocky Boy's Reservation—The Role of Community and of the Trustee*, 16 J. ENVT. L. & POL'Y 255 (1998) (water negotiations in which the leadership of key people within the Tribal leadership and the local community led to a novel effort to develop a joint drinking water system).

governmental organizations.[199] Administrative law and institutional structure cannot mandate the type of personality involved, but could be designed to maximize diversity, thus increasing the likelihood that these personality types are represented. In addition, organizational structures may be set up to provide positions and incentives for people who play the roles of maven, connector, and entrepreneurial leader.[200] Universities have the responsibility for educating this type of manager.

The groundwork for connecting local knowledge and input to national level decisions has been laid in the Columbia River basin by the formation of the NWPCC on the U.S. side and its sub-basin planning process, and by the CBT on the Canadian side through its grassroots origins. However, the connection between this increased local and regional capacity and the Treaty implementing entities does not cover the range of communication and coordination necessary for resilience. Admittedly, overlapping authority over the storage and release of water on a connected river system would present a problem. But this is purely a technical coordination function focused on the operation of dams. In governance terms, the overlapping authority would not be for daily operation, but for the provision of power, flood control, and ecosystem health. Considered in this light, it may not be the 1964 Columbia River Treaty for technical operation of existing storage and hydropower production that requires modification, but a new treaty giving political level oversight and decision making or coordination on broader issues. It is at this level of decision making that the input of the public carries sway.

Meaningful public participation: As noted above, meaningful public participation is more than a checklist under NEPA regulations of: (1) making information available; (2) allowing public comment; and (3) responding to public comment.[201] Meaningful public participation means a flow of information in both directions with agencies incorporating local knowledge where appropriate. Meaningful public participation requires that the exchange of information and input occur at a time and place convenient to local citizens whose participation is unpaid. This may require attendance by agency personnel at community meetings that are already scheduled on a regular basis, rather than holding separate meetings.[202] For a long-term, complex process, it may also require funding for the participation of local leaders. Finally, meaningful public participation means that the public input has some influence over the final decision if appropriate. This aspect is difficult to accomplish at the agency level. Generally agencies can only act within the scope of their authority. At the federal level in the U.S., taking advice from a citizen's group runs into the concerns of the Federal Advisory

[199] Ruhl & Salzman, *supra* note 54, at 44-45.

[200] Clearly there is also a role for our institutions of higher education in educating students with the skills necessary to bring people together and to communicate across boundaries.

[201] 40 C.F.R. § 1503 (2010).

[202] Barbara Cosens, *Water Dispute Resolution in the West: Process Elements for the Modern Era in Basin-wide Problem Solving*, 33 ENVTL. L. 949, 1014 (2003).

Committee Act,[203] passed to assure that federal agency decision making is accountable. The development of political commissions[204] at the scale of the social-ecological system, rather than agency advisory groups, can provide a politically accountable body that can respond to public input.

It is also difficult to imagine "meaningful public participation" at the scale of a river basin the size of the Columbia. The term used in symposium discussions to describe a manageable process of this magnitude was "nested" public input. The author has written about this in the context of state-federal-tribal negotiations concerning water and divided the interests into three concentric circles: those with direct interest in water; basin communities; and the public at-large.[205] In the case of the Columbia River basin, as is appropriate in negotiation of an international treaty, those actually at the table must be federal level representatives (i.e., for negotiation of an international treaty: the United States, the State Department; for Canada, Ministry of Foreign Affairs and Trade). However, the three areas of concentric circles correspond to: (1) direct water interests: states, province, Native American Tribes, First Nations; (2) basin communities: the broader range of interests represented by the Columbia Basin Trust and the sub-basin planning process of the NWPCC; and (3) the public-at-large: fishing and hydropower interests outside the basin. Given this degree of organization within the basin, each level has an existing structure that can be used to develop input. This approach does not mean that every concern or proposal from the public will be used. In fact, the purpose of representation by an entity at each level is to have decision makers who can reconcile differences and choose between competing interests. While consensus is a laudable goal, with issues as complex as water management requiring hard choices and tradeoffs, consensus is an unlikely result.[206]

Local capacity building: The ability to respond to changed circumstances in a social-ecological system, similar to the ability to respond to an emergency, requires an infusion of resources at the local level. Although it is often said that a

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[203] Federal Advisory Committee Act (FACA), Pub. L. 92-463, 86 Stat. 770 (1972), as amended by Pub. L. 94-409, § 5(C), 90 Stat. 1247; Pub. L. 96-523, § 2, 94 Stat. 3040 (1980); Pub. L. 97-375, Title II, §201(C), 96 Stat. 1822 (1982); Pub. L. 105-153, §2(A), (B), 111 Stat. 2689 (1997).

[204] Craig Thomas, *The Impact of Institutional Design on the Adaptability of Governing Institutions: Implications for Transboundary River Governance, in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article at 17, on file with author).

[205] Cosens, *supra* note 202, at 947.

[206] *See, e.g.,* Zellmer & Gunderson, *supra* note 50, at 942

> One of the key lessons learned from both the Everglades and the Glen Canyon Dam restoration projects is that "providing ad hoc, vague directives for experimental, collaborative regulatory processes invites delay and indecision to the detriment of those resources harmed by inaction.". . . Although collaborative stakeholder groups can provide guidance to restoration scientists and managers "about the kinds of issues to study and the kinds of risks that are acceptable in formulating and conducting adaptive management experiments," restoration plans, to be successful, must be unfettered from rigid consensus building requirements and free to experiment "without constant micromanagement."

(internal citations omitted).

million individual actions can be more effective than a single large governmental response,[207] it is amazing how quickly we turn to a higher level of government when a problem occurs. Yet it is on the local level, not the level of an entity like the Department of Homeland Security, that a major portion of the resources are needed for response to events like Hurricane Katrina, 9-11, or the 1948 Vanport flood.[208] This capacity to respond quickly in a manner that can be instantly tailored to the nature of the event is both more intuitive and thus easier to sell to the public, when the topic is a natural disaster with high potential for property damage and loss of life. Yet even so, we often lack the necessary resources at the local level.[209] Thus, it is not difficult to understand that when local action is needed to address a problem that manifests over a period of time, in a different location, the political will to fund the problem is lacking.

The Columbia River Treaty provides a lesson in how to address the problem of local capacity. Why would Canada build dams in its territory for the benefit of power production in the United States? The concept of the Canadian Entitlement for the sharing of benefits across the international boundaries, and the thirty-year initial sale of the entitlement provided the necessary incentive. As Vogel points out in her contribution to the forthcoming Columbia Symposium volume, the formation of the international treaty allowed the basin to develop as a region.[210] It is on this scale that benefits of local action must be distributed.

Authority to respond to changes in circumstances across a range of scenarios: The separate work of Greg Hill and Craig Thomas presented at the Symposium provide an excellent framework for understanding the needs of governance in the face of uncertainty. Both suggest that while existing frameworks for agency management are appropriate for management and adaptive management in the face of predictable variability, the existing framework may not be appropriate for response in a complex system in which uncertainty is "not reducible by further research,"[211] or, in the framework of Thomas, to "wicked" problems in which the actors are unable to agree on either the problem definition or the solution.[212] Both presenters agreed that a new form of governance is needed

[207] "Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it's the only thing that ever has." Margaret Mead, *as quoted in* AND I QUOTE: THE DEFINITIVE COLLECTION OF QUOTES, SAYINGS, AND JOKES FOR THE CONTEMPORARY SPEECHMAKER (Ashton Applewhite et al. eds., 1992).

[208] It should be noted that a coordinated effort at a high level may be exactly the response needed to reduce uncertainty (e.g. Homeland Security may allow the U.S. to reduce the possibility of another terrorist attack), however, in areas like climate change and terrorism where uncertainty can never be reduced to zero, a robust local and multi-level response capability is necessary.

[209] *See, e.g.,* NATIONAL COMMISSION ON TERRORIST ATTACKS UPON THE UNITED STATES, EXECUTIVE SUMMARY: 9-11 COMMISSION REPORT 13 (2004), *available at* http://govinfo.library.unt.edu/911/report/index.htm ("Despite weaknesses in preparations for disaster, failure to achieve unified incident command, and inadequate communications among responding agencies . . .").

[210] *See generally* Vogel, *supra* note 193.

[211] Gregory Hill et al., *Uncertainty Society and Resilience: A Case Study in the Columbia River Basin*, *in* COLUMBIA SYMPOSIUM, *supra* note 67 (draft article at 20, on file with author).

[212] Thomas, *supra* note 204, at 171.

in this complex situation. Thomas recommended politically appointed councils,[213] while Hill called for a more general framework in which an extended peer community continually assesses knowledge and is coupled with a "robust system for managing and communicating uncertainty."[214] Both approaches differ from current agency adaptive management by allowing decision-making outside the current legislative framework while maintaining a degree of accountability through a political or peer selection process. This seems strikingly similar to the description of adaptive governance in the resilience literature.[215]

An example is Montana's process for achieving settlements concerning the water rights of Native American and federal reservations within the state. Unlike the federal government or other states that designate agency personnel to represent their government in negotiations,[216] Montana relies on a politically appointed commission[217] with the authority to coordinate positions among state agencies[218] and private stakeholders, and to make final decisions among conflicting positions. Final settlements are submitted to the legislature[219] to provide an additional level of political accountability, to assure state citizens are bound, and to authorize any state agency action outside its existing authority. Not only does this provide an entity with the flexibility to respond differently to different circumstances, but in practice it has achieved support for its final settlement in the legislature by viewing its primary functions as the coordination of the two-way flow of information among agencies and between agencies and the public, and the design of creative

[213] *Id.*

[214] Hill et al., *supra* note 211, at 21.

[215] *See generally* Folke et al., *supra* note 44.

[216] *See* Criteria and Procedures for the Participation of the Federal Government in Negotiations for the Settlement of Indian Water Rights Claims, 55 Fed. Reg. 9223 (Mar. 12, 1990).

[217] MONT. CODE ANN. § 85-2-701 (West 2009) ("it is further intended that the state of Montana proceed under the provisions of this part in an effort to conclude compacts for the equitable division and apportionment of waters between the state and its people and the several Indian tribes claiming reserved water rights within the state."); MONT. CODE ANN. § 2-15-212 (West 2009) ("(2) Subject to 5-5-234, commissioners are appointed as follows: (a) two members of the house of representatives appointed by the speaker, one from the majority party and one from the minority party; (b) two members of the senate appointed by the president, one from the majority party and one from the minority party; (c) four members designated by the governor; and (d) one member designated by the attorney general."). *See also* Montana Reserved Water Rights Compact Commission, http://dnrc.mt.gov/rwrcc/default.asp (last visited Mar. 20, 2010).

[218] Memorandum of Understanding among: The Office of Governor, The Office of the Attorney General, The Montana Reserved Water Rights Compact Commission, The Office of the Director of Natural Resources and Conservation, and The Office of the Director of Fish, Wildlife and Parks, Concerning: The Negotiation of Settlements with Tribes and Federal Agencies Claiming Reserved Water in Montana (Feb. 2, 1990) (on file with author).

[219] MONT. CODE ANN. § 85-2-702(2) (West 2009)

> When the compact commission and the Indian tribes or their authorized representatives have agreed to a compact, they shall sign a copy and file an original copy with the department of state of the United States of America and copies with the secretary of state of Montana and with the governing body for the tribe involved. The compact is effective and binding upon all parties upon ratification by the legislature of Montana and any affected tribal governing body, and approval by the appropriate federal authority.

solutions to resolve any resulting conflicts. In the author's experience as a negotiator for the Commission,[220] the entity rarely had to choose between competing positions. The mere existence of that authority, backed by its standing with the legislature due to its legislator participants, combined with the effort to ensure that interests at all levels held the same information, made it unnecessary to wield a heavy hand. Instead, the Commission and its staff performed the roles of maven, connector and entrepreneurial leader. The Commission may provide a useful approach to the coordination of solutions to wicked problems.

CONCLUSION

Fostering resilience in social-ecological systems is a choice that we, as a democratic society, can make if we desire to continue to receive the massive benefits of the ecosystems we rely on. It is not the path we are currently on as reflected in our administrative framework, our substantive natural resource law, and specifically, our management of the Columbia River. Should we choose resilience, restructuring the current system is no small task. This paper looks primarily at the administrative framework that must change from the model of massive state and federal agencies taking a command and control approach to an infusion of resources and capacity building at the local level, while retaining overlapping state, federal and international programs to provide oversight and research and to coordinate across multiple jurisdictions. Such reform will require authorization for greater flexibility in decision-making while relying on public participation and input as a large source of accountability. It will require expenditures on monitoring the effects of decisions and the flexibility to respond to the results of monitoring. In short, the recognition of the complexity in the social-ecological system, coupled with our growing realization of the complete dependence of the human race on the ability of the ecological system to serve it, requires reform of the administrative state to allow us, as a responsible society, to respond to the challenge of managing multi-jurisdictional watersheds.

[220] The author served as lead negotiator for the Commission in negotiations achieving settlement of the water rights of: the Chippewa Cree Tribe of the Rocky Boy's Reservation, Yellowstone National Park, Glacier National Park, Big Hole National Battlefield, Little Bighorn Battlefield National Battlefield, Bighorn Canyon National Recreation Area, Red Rock Lakes National Wildlife Refuge, Black Coulee National Wildlife Refuge, and Benton Lake National Wildlife Refuge.