RESILIENCE, ADAPTATION, AND TRANSFORMATION IN THE KLAMATH RIVER BASIN SOCIAL-ECOLOGICAL SYSTEM

BRIAN C. CHAFFIN,*ROBIN KUNDIS CRAIG,**AND HANNAH GOSNELL***

ABSTRACT

The Klamath River Basin straddles northern California and southern Oregon and has been the locus of a century-long struggle for multivalent resilience—resilience of resident Native American tribes in the face of settlement by Europeans and others, resilience of immigrant settlers pursuing agriculture in a water-limited environment, and resilience of native ecosystems and fish species in the face of significant hydrologic fragmentation via dams and irrigation infrastructure resulting in severely reduced access to and changes in habitat. Recently, however, the communities of the Klamath Basin have worked together in an effort to transform regional environmental governance to promote greater resilience across all these valences.

This article uses the four-phase adaptive cycle model that Lance Gunderson and C.S. Holling described in 2002 to trace the history of the Klamath Basin social-ecological system ("SES") through periods characterized by vulnerability, resilience, and transformation. We conclude that while Klamath Basin stakeholders have worked out a compromise settlement that may signify the emergence of a new, more resilient regime of environmental governance, the Basin's future is uncertain. We identify important thresholds that, if triggered, could move the SES into alternate regimes, and we consider whether formalization of emergent institutions through legislation might influence this trajectory.

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I. INTRODUCTION

The Klamath River Basin of south central Oregon and northern California provides an excellent case study for scholars interested in resilience, adaptation, and transformation in environmental governance regimes, particularly with respect to the role that law has played—and will continue to play—in regime shifts over time. The Klamath is currently at a crossroads, where an impressive suite of potential solutions to a variety of social, ecological and economic problems has been developed through a basin-scale collaborative process characterized by increased social capacities such as enhanced trust, cooperation, and communication. The emerging regime has the potential to enhance and restore ecosystems, livelihoods, and social wellbeing. However, the federal government has yet to formally recognize and support the basin's plan. As such, currently there are any number of potential futures for the basin and a number of looming thresholds that, if crossed, could trigger dynamics that push the current system into an alternate regime.

This paper employs the theoretical concepts of resilience—specifically the adaptive cycle heuristic model—to make sense of social and ecological changes in the basin since Euro-American settlement in the late 19th century. Employing the adaptive cycle heuristic enables characterization of dynamic cross-scale interactions across three distinct, but intimately connected, Klamath landscapes: the legal landscape, the social landscape, and the biophysical landscape. The overall aim of the paper is to illustrate the utility of assessing changes in the historic and contemporary resilience of social-ecological systems ("SESs") through the lens of the adaptive cycle in order to highlight the role environmental governance can play in facilitating or preventing regime shifts associated with the crossing of significant social, economic, and ecological thresholds. To that end, in Part II we present the theoretical and practical foundations for our approach, and introduce the Klamath Basin case in terms of history, geography, and environmental governance. Part III characterizes the history of the Klamath Basin in terms of the dynamic phases of the adaptive cycle. We highlight the important role that legal and social dynamics associated with federal and state laws, policies, and court cases have played in the transition between phases. We argue that shifting patterns of resilience in the Klamath SES are in many ways a function of uneven and changing implementation of federal laws such as the Endangered Species Act[1] and federal obligations associated with tribal sovereignty and Indian water rights. Part IV draws on the previous analysis to consider future perturbations associated with climate change impacts, politics, and lack of funding to implement collaborative solutions, described in a state and transition model that depicts alternate regimes characterized by different social, economic, and ecological dynamics. We conclude that while Klamath Basin stakeholders have worked out a compromise settlement that could move the Klamath Basin toward greater resilience in terms of both social relations and ecosystem function, future perturbations may leave this SES vulnerable to unanticipated regime shifts if recent governance innovations are not formally institutionalized.

1. Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1542 (2012).

II. ASSESSING THE RESILIENCE OF THE KLAMATH BASIN SES

A. Why Resilience? The Resilience Assessment Process

The purpose of assessing the Klamath River Basin's resilience is partly an effort, in the words of the *Resilience Alliance* handbook, "to help policy makers, managers, users, and other stakeholders who would like to know if existing policies, or proposed new policies, are likely to achieve their stated aims."[2] In addition, this effort is part of a larger inquiry into the nature of resilience in large-scale river basins[3] and a broader assessment of whether explicitly analyzing a system's resilience can aid in the identification of barriers and/or bridges to transforming environmental governance of basin resources towards a more "adaptive governance"[4]—environmental governance operating under the uncertainty associated with complex SESs and contemporary global change. Resilience is a property of complex systems and can be described or measured in one of two ways: 1) by the ability of a system to "bounce back" or return to a stable state after a disturbance (engineering resilience); and 2) by the amount of disturbance that can be absorbed by the system before it changes to a new state controlled by a new set of variables (ecosystem resilience).[5]Assessing ecosystem resilience (as we attempt here) can help environmental governance actors ascertain SES susceptibility to transformative change and inform consideration of: (1) whether such change is desirable or undesirable; (2) if transformation is undesirable, the potential for avoiding an imminent threshold and successfully adapting to maintain current system functionality despite changing conditions (e.g., adapting to new fire and/or drought regimes without completely losing forests); or (3) if transformation is desirable (e.g., more amenable to growing staple crops) or unavoidable (e.g., the melting of the Arctic tundra), the options for facilitating or managing the regime shift to produce the least social and cultural disruption. In addition, the resilience assessment process should help governance actors to identify means of adapting the relevant governance regime(s) to promote—or at least stop impeding—the desired or "best case" social-ecological outcome given changing conditions.

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2. RESILIENCE ALLIANCE, ASSESSING RESILIENCE IN SOCIAL-ECOLOGICAL SYSTEMS: A WORKBOOK FOR SCIENTISTS 4 (Version 1.1, 2007), *available at* https://ia600508.us.archive.org/35/items/resilience_workbook_for_scientists/resilience_workbook_for_scientists.pdf.

3. *See Social-ecological System Resilience, Climate Change, and Adaptive Water Governance*, NAT'L SOCIO-ENVIRONMENTAL SYNTHESIS CENTER, http://www.sesync.org/project/water-people-ecosystems/adaptive-water-governance (last visited Jan. 9, 2015) (describing this project sponsored by the National Socio-Environmental Synthesis Center, University of Maryland, and funded by the National Science Foundation).

4. "Adaptive Governance" is defined as "a range of interactions between actors, networks, organizations, and institutions emerging in pursuit of a desired state for social-ecological systems." Brian C. Chaffin, Hannah Gosnell, & Barbara A. Cosens, *A Decade of Adaptive Governance Scholarship: Synthesis and Future Directions*, 19 No. 3 ECOLOGY & SOC'Y Art. 56 (2014), *available at* http://www.ecologyandsociety.org/vol19/iss3/art56/.

5. LANCE H. GUNDERSON & C. S. HOLLING, PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS 27–28 (Lance H. Gunderson & C. S. Holling eds., Island Press 2002) [hereinafter GUNDERSON & HOLLING].

Multiple frameworks have been developed for assessing resilience in SESs;[6] but no consistent approach or application of this process has yet emerged because of the highly contextual and complex nature of SESs. The proposed frameworks for conducting resilience assessments require large amounts of data, some of which may be highly technical or difficult to obtain because of the political nature of the information requested. With this in mind, and starting with the premise that there is no "right way" to describe and assess the resilience of an SES, we have adapted the narrative style presented in the *Assessing Resilience in Social-Ecological Systems: A Workbook for Scientists*, published by the Resilience Alliance in 2007.[7]We base our narrative primarily on a literature review focused on historical and current social and ecological conditions of the basin, including the management of key resources and the cross-scale interactions inherent in biophysical, economic, cultural, legal, and political phenomena that act upon the Klamath River system. We also integrate insights from recent fieldwork in the basin[8] aimed at uncovering details and drivers of historic and contemporary governance transitions, including the emergence and evolution of community-based collaborative conservation. In doing so, we subscribe to Walker and Salt's observation that "following strict recipes and prescriptions simply isn't appropriate" because "[r]esilience is a dynamic property . . . and managing for it requires a dynamic and adaptive approach."[9]They instead suggest "three broad steps" of resilience-based activities for SES research and practice: "*describing* the system, *assessing* its resilience, and *managing* its resilience."[10]This paper aims to achieve the first two steps, describing and assessing the transient property of resilience in the context of the Klamath River Basin SES.

B. The Klamath Basin

The Klamath River Basin of south central Oregon and northern California is a SES in the midst of a remarkable ecological, social, and legal transformation, necessitated by increasing and potentially irreversible environmental degradation occurring in tandem with growing social conflict over the past century. We delineate the Klamath Basin SES in the following ways: (1) spatially by the Klamath Basin topographical watershed boundary; (2) temporally by the most recent settlement of indigenous peoples through present day; and (3) legally by initial structural changes to the system followed by an increasing and countervailing role for the federal Endangered Species Act and tribal water rights. Beginning with the displacement of

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6. *Id*; *see also* RESILIENCE ALLIANCE, *supra* note 2; Brian Walker et al., *Resilience Management in Social-ecological Systems: A Working Hypothesis for a Participatory Approach*, 6:1 CONSERVATION ECOLOGY June 2002, at art. 14, *available at* http://www.consecol.org/vol6/iss1/art14/.

7. RESILIENCE ALLIANCE, *supra* note 2, at 20–22.

8. *See generally* Hannah Gosnell & Erin Clover Kelly, *Peace on the River? Social-Ecological Restoration and Large Dam Removal in the Klamath Basin, USA*, 3 WATER ALTERNATIVES 362, 362 (2010), (presenting additional fieldwork and research), *available at* http://www.water-alternatives.org/index.php/alldoc/articles/vol3/v3issue2/98-a3-2-21/file; Brian C. Chaffin, Reallocating Resources, Rebuilding Community: The Klamath Basin Agreements and the Emergence of Adaptive Governance (May 20, 2014) (unpublished Ph.D. dissertation, Oregon State University) (on file with Scholars Archive, Oregon State University), *available at* https://ir.library.oregonstate.edu/xmlui/handle/1957/50604.

9. BRIAN WALKER & DAVID SALT, RESILIENCE PRACTICE: BUILDING CAPACITY TO ABSORB DISTURBANCE AND MAINTAIN FUNCTION 1 (2012).

10. *Id.*

native peoples by Euro-American settlers in the mid- to late-19th century,[11] an economy based on ranching, farming and forestry was established in the upstream portions of the basin, a landscape defined by the transient, seasonal nature of water movement.[12] To support this extraction-based economy, the federal government invested in highly technological irrigation and drainage infrastructure that resulted in significant ecological modification. In addition, the basin is roughly shaped like an hourglass,[13] and at its narrowest point, a series of hydroelectric dams punctuate the mainstem river system,[14]creating a highly connected system of water management but blocking passage for anadromous[15] fish species from the Pacific Ocean and further complicating an already degraded and nutrient-rich water supply from the agriculturally-dominated Upper Basin.[16]

The result of these drainage, irrigation, and hydroelectricity projects has been the steady privatization, division, and eventual over-allocation of land and water resources across an increasingly "hybridized" Klamath landscape.[17]The downstream portions of the basin have experienced the consequences of upstream projects such as the loss of natural river flow variability and the steadily decreasing returns of Klamath river salmon and steelhead trout species—fish vital to the culture of indigenous tribes, and fish that support a recreational river fishery and a commercial salmon fishery off the coasts of Oregon, Washington, and parts of northern California.

For over a century, generations of Euro-American settlers in the Klamath have sought to maintain a system of agricultural production and resource consumption established in the early 1900s, rigidly resisting perturbations stemming from resource degradation, social conflict, and legal change that threatened to shift the state of the system's social-ecological function.[18]Over the last fifty years, however, the cycle of slow system-controlling variables has intersected with rapidly moving variables at different scales to cause acute disturbances in both the social and ecological parts of the system, precipitating a release and transition into a state of chaotic reorganization.[19]Recognizing the untenable configuration of system variables and the critical role that federal, state, and local laws, policies and institutions have

11. HOLLY DOREMUS & A. DAN TARLOCK, WATER WAR IN THE KLAMATH BASIN: MACHO LAW, COMBAT BIOLOGY, AND DIRTY POLITICS 59–70 (2008); STEPHEN MOST, RIVER OF RENEWAL: MYTH AND HISTORY IN THE KLAMATH BASIN 1–40, 67–93 (2006).

12. DOREMUS & TARLOCK, *supra* note 11, at 37–58.

13. *Id.* at 24.

14. *Id.* at 51.

15. "Anadromous" refers to a life history of "migrating from salt to fresh water." ROGER J. LINCOLN ET AL., A DICTIONARY OF ECOLOGY, EVOLUTION, AND SYSTEMATICS 14 (2d ed. 1983). In the Klamath Basin, anadromous refers to several species of salmonids born in the freshwater tributaries and mainstem of the Klamath River, then migrating to marine environments for the majority of their juvenile and adult life, returning again to natal streams to spawn.

16. PAUL ZEDONIS ET AL., ASSESSMENT OF LONG TERM WATER QUALITY CHANGES FOR THE KLAMATH RIVER BASIN RESULTING FROM KHSA, KBRA, AND TMDL AND NPS REDUCTION PROGRAMS 3 (2011), *available at* http://klamathrestoration.gov/sites/klamathrestoration.gov/files/Final%20Klamath%20WQ%20Changes%20Analysis%20Approach_08_18_2011.pdf.

17. The addition of irrigation in the U.S. West created a "hybrid landscape." MARK FIEGE, IRRIGATED EDEN 9, 205 (1999).

18. *Id.* at 79.

19. GUNDERSON & HOLLING, *supra* note 5, at 32–52.

played in the worsening of the situation, groups of basin stakeholders have attempted to reorganize the system's regime of environmental governance by adjusting resource management applications to reflect a more flexible, adaptive approach that values local livelihoods and culture while also conforming to higher level environmental law and policy.[20]

1. Biophysical Setting

The Klamath River Basin is a complex landscape, both socially and ecologically. Over 15,000 square miles in area, the basin is bigger than the state of Maryland.[21]It straddles two states, eight counties, and contains a myriad of federal, state, county, and municipal land bases [Figure 1]. The watershed boundary of the basin unites the Klamath as a bioregion—a region defined by its natural (physical), as opposed to social (administrative), boundaries. The connecting feature of the basin, the Klamath River, flows more than 350 miles from the high Oregon desert through the southern Cascade Mountains and then southwest to the Pacific Ocean, with the river's mouth located just south of present day Crescent City, California.[22] The Klamath is the second longest river in California behind the Sacramento River and boasts the third most productive salmon spawning habitat on the U.S. Pacific Coast.[23] Through geologic and geomorphic processes that span millennia, the Klamath Basin has taken the form of a rich landscape of abundant physical and biological resources, and the resulting geography has encouraged human settlement and cultural development over at least the past 11,000 years.[24]

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20. *See generally* U.S. DEP'T OF THE INTERIOR, KLAMATH BASIN RESTORATION AGREEMENT FOR THE SUSTAINABILITY OF PUBLIC AND TRUST RESOURCES AND AFFECTED COMMUNITIES 146 (2010), *available at* http://klamathrestoration.gov/sites/klamathrestoration.gov/files/Klamath-Agreements/Klamath-Basin-Restoration-Agreement-2-18-10signed.pdf [hereinafter KBRA]; U.S. OF THE INTERIOR, KLAMATH HYDROELECTRIC SETTLEMENT AGREEMENT 2–3 (2010), *available at* http://klamathrestoration.gov/sites/klamathrestoration.gov/files/Klamath-Agreements/Klamath-Hydroelectric-Settlement-Agreement-2-18-10signed.pdf [hereinafter "KHSA"]. .

21. NAT'L RESEARCH COUNCIL, NAT'L ACAD. OF SCIENCES, HYDROLOGY, ECOLOGY, AND FISHES OF THE KLAMATH RIVER BASIN *xiii* (2008) [hereinafter 2008 NRC KLAMATH HYDROLOGY REPORT]. In comparison, according to the Maryland Geological Survey, the state of Maryland is 12,193 square miles in area. Md. Geological Survey, *Land Areas, Inland-Water Areas, and Length of Shorelines of Maryland's Counties*, MD. DEP'T OF NAT. RESOURCES, http://www.mgs.md.gov/geology/areas_and_lengths.html (last visited Jan. 9, 2015).

22. NAT'L RESEARCH COUNCIL, NAT'L ACAD. OF SCIENCES, ENDANGERED AND THREATENED FISHES IN THE KLAMATH RIVER BASIN: CAUSES OF DECLINE AND STRATEGIES FOR RECOVERY 46–47 (2004) [hereinafter 2004 NRC KLAMATH FISHES REPORT] (describing physical nature of boundaries).

23. *See* U.S. DEP'T OF THE INTERIOR & CAL. DEP'T OF FISH AND GAME, STATE CLEARINGHOUSE NO. 2010062060, KLAMATH FACILITIES REMOVAL DRAFT ENVIRONMENTAL IMPACT STATEMENT/ENVIRONMENTAL IMPACT REPORT 1–4, 1–6 (2011)[hereinafter DRAFT KLAMATH EIS/EIR], *available at* http://klamathrestoration.gov/sites/klamathrestoration.gov/files/KlamathFacilitiesRemoval_EISEIR_09222011.pdf.

24. 2008 NRC KLAMATH HYDROLOGY REPORT, *supra* note 21, at 57.

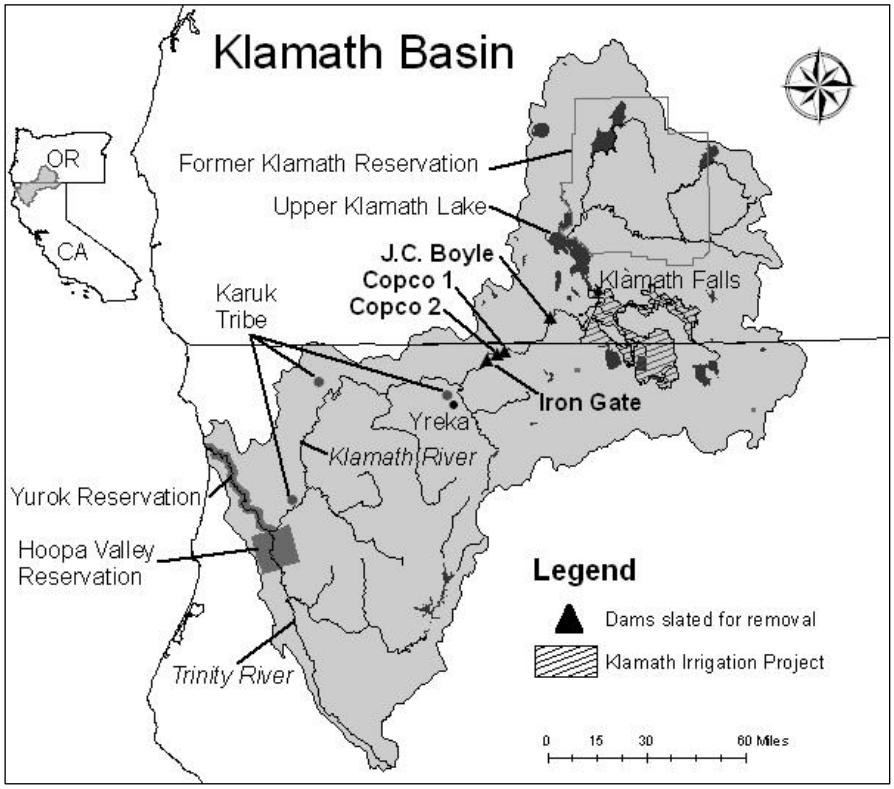

FIGURE 1. Klamath Basin Map[25]

Understanding the hydrology of the Klamath Basin may be the key to grasping the basin's potential for regime shift. The southern reach of the Cascade Mountains roughly divides the basin in half and creates a rain shadow effect, capturing moisture emanating from the Pacific Ocean. The west face of the Cascades and the lower portion of the Klamath River Basin can receive over five times the rainfall received on the eastern Cascade slopes of the Upper Klamath Basin.[26]Water that falls as snow or rain near the headwater reaches of the Klamath catchment supplies the Wood, Sycan, Sprague, and Lost Rivers, which then coalesce in a series of marshes and lakes, ebbing and flowing with the seasonal freeze and thaw of the Cascade snowpack. They feed into Upper Klamath Lake, the largest lake by surface area in Oregon. Because of naturally occurring phosphorus, the lake is naturally eutrophic, but the addition of nutrients from agricultural runoff has increased the likelihood of blue-green algae blooms, which threaten native fish habitat.[27]

25. Gosnell & Kelly, *supra* note 8, at 364..

26. This figure is based on a precipitation comparison between Klamath Falls, Oregon (Upper Basin, 13.72 inches annually); Klamath, California (Lower Basin, 80.22 inches annually); and Happy Camp, California (Middle Basin/Upper Lower Basin, 51.74 inches annually). *See Recent Climate in the* West, W. REGIONAL CLIMATE CENTER, http://www.wrcc.dri.edu/ (last visited Jan. 9, 2015).

27. ZEDONIS ET AL., *supra* note 16, at 3–4.

Historically, the lakes of the Upper Klamath Basin[28] were surrounded by intermittent wetlands capable of handling the seasonal pulse of water. The remaining system of lakes and marshes supports a variety of fish with life histories adapted to shallow intermittent waters. The most infamous of these species are the Lost River (*Deltistes luxatus*) and short nose (*Chasmistes brevirostris*) suckers.[29] The first inhabitants of the Upper Basin found suckers to be plentiful and a rich food source; as a result, the suckers became central to native subsistence patterns, ceremony, and general culture.[30] In addition, the marshes and lakes of the Upper Klamath Basin provide an important stopover for migratory bird species along the U.S. portion of the Pacific flyway that stretches from Alaska to South America.[31]

The collection of seasonal waters from the Upper Basin carves a path through the Cascades over a shelf-like reef structure at the site of present day Keno Dam, which serves roughly as the dividing line between the "Upper" and "Lower" portions of the basin and the outlet for waters of the Upper Basin.[32]In the Lower Klamath Basin, coho and Chinook salmon as well as steelhead trout[33] return each year to tributaries of the Klamath River in search of their natal spawning streams after spending the majority of their juvenile and adult life feeding in marine environments.[34]Native peoples in the lower and middle portions of the Klamath River Basin developed a culture around salmon as a food source and a revered cultural symbol.[35]In addition, today's yearly Klamath salmon runs are critical to the health and viability of a Pacific coast commercial salmon fishery off the coasts of Oregon, Washington, and parts of northern California.[36]

2. Social Context

The first known inhabitants of the Klamath Basin adopted subsistence patterns and cultural practices in synchrony with varied landscape patterns and resources from the upper reaches of the basin to its coastal mouth. For example, the Hupa,[37]Karuk, and Yurok peoples of the Lower Basin coordinated a series of annu-

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28. Including Upper Klamath Lake, Lower Klamath Lake, Clear Lake, Tule Lake, and others. 2008 NRC KLAMATH HYDROLOGY REPORT, *supra* note 21.

29. *See generally id;* 2004 NRC KLAMATH FISHES REPORT, *supra* note 22.

30. MOST, *supra* note 11, at 8.

31. ROBERT M. WILSON, SEEKING REFUGE: BIRDS AND LANDSCAPES OF THE PACIFIC FLYWAY 26 (2010).

32. 2008 NRC KLAMATH HYDROLOGY REPORT, *supra* note 21, at 54.

33. This is the same species as rainbow trout (*Oncorhynchus mykiss*), but with a salmonid-like, anadromous life history. 2004 NRC KLAMATH FISHES REPORT, *supra* note 22, at 270–74.

34. *Id.*at 250–86.

35. MOST, *supra* note 11, at xix–xx.

36. Glen Spain, *Dams, Water Reforms, and Endangered Species in the KlamathBasin*, 22 J. ENVTL. L. & LITIG. 49, 83–85 (2007).

37. *See* Judith Y. Messier, Conflict in the Klamath Watershed and a Relationship-Building Framework for Conflict Transformation129 (Apr. 26, 2012) (unpublished Ph.D. dissertation, George Mason University) (on file with Mason Archival Repository Service). For a description of legal and cultural distinctions between the terms "Hupa" and "Hoopa" or "Hoopa Valley Tribe." For the purposes of this paper, we use the term "Hupa" to refer to a culturally distinct band of Indians living along the Klamath River around the mouth of the Trinity River and toward the coastal mouth of the Klamath River. We use "Hoopa Valley" or "Hoopa Valley Tribe" to refer to members of the federally recognized Indian nation occupying the Hoopa Valley Indian Reservation located at the confluence of the Trinity and Klamath Rivers. Importantly "not all Hupa are Hoopa and not all Hoopa are Hupa." *Id.* at 129–30.

al and biannual ceremonies around the cyclical return of salmon to the river, integrating elements of both harvest and management into their traditions.[38]Ancestors of the Klamath, Modoc, and Yahooskin Snake of the Upper Basin (now recognized together as "The Klamath Tribes")[39] were known as "peoples of the lake" and still hold a tradition of awaiting the return of breeding suckers or "*c'waam*" to the tributaries of the Upper Basin each spring, harvesting fish and celebrating the event with a formal ceremony.[40]

Today, the Lower Klamath Basin is home to three relatively large federally recognized tribes—the Hoopa Valley, Karuk, and Yurok—and two smaller tribes, the residents of the Resighini Rancheria and the Quartz Valley Indian Reservation, while the Upper Klamath Basin is home to the federally recognized Klamath Tribes.[41] Despite the current lack of any significant economic engine,[42] the Hoopa Valley, Karuk, Klamath, and Yurok Tribes have all built substantial natural resources departments and fisheries programs and participate in the comanagement of Klamath River resources along with state and federal agencies.[43]

The Upper Klamath Basin is also now home to a number of rural agricultural communities,[44] which were established in the late 1800s, partly in response to fed-

38. MOST, *supra* note 11, at xix. Ancestral tribes of the Lower and Middle Klamath Basin, including the Yurok and Hupa people (Lower) and the Karuk and Shasta people (Middle), were among the last native peoples in the contiguous 48 American states to be contacted by Europeans, a result in part of the remoteness and ruggedness of the Lower Basin and the lack of any beckoning account by early Euro-American trappers and explorers. The saga of the Lower Klamath Basin tribes has been defined by a struggle throughout the 20th century to maintain access to salmon fishing. Only the Hoopa Valley and the Yurok retained reservation land after initial Euro-American settlement of the basin. Moreover, it wasn't until 1975 that tribal rights to harvest salmon with traditional gillnets were recognized on the lower river and 1991 when tribal rights to a percentage of annual salmon harvest was legally quantified

39. As the U.S. Court of Federal Claims has explained, "[t]he present-day Klamath Tribes is a single, federally-recognized tribal government that uses the plural 'Tribes' to reflect the fact that it is composed of the Klamath and Modoac Tribes, and the Yahooskin Band of Snake Indians." Klamath Tribe Claims Comm. v. United States, 106 Fed. Cl. 87, 88 n.1 (2012). In 1864, the Klamath Tribes signed a treaty in which they ceded over 8 million hectares of their homeland for a reservation of 800,000 hectares, but they reserved hunting and fishing rights on the land that they ceded.. The Tribes have long claimed reserved water rights for their reservations through the *Winters* doctrine as well as additional treaty rights to use and support the basin's various species of fish and wildlife. Along with many other tribes in the U.S., the Klamath Tribes were terminated in 1954 as part of federal assimilation policy, and their reservation was taken from them. As legal scholars Holly Doremus and Dan Tarlock note, "[t]he loss of tribal lands severely crippled the Klamaths*See id.* at 89..Tribal status was restored in 1986, but no land was returned, leaving the tribes with the meager ownership of approximately 372 acres as of 2008. Recently, the tribal community has rebounded from the extreme poverty and social ills that befell the tribe post-termination,and today the Tribes are focused on increasing their capacity to manage water and associated natural resources as a means of preserving their cultural heritage.To further this aim and improve overall economic wellbeing, the return of a tribal land base continues to be a key concern for the Klamath Tribes.

40. MOST, *supra* note 11, at 8.

41. DRAFT KLAMATH EIS/EIR, *supra* note 23, at 1–8 to 1–10.

42. DOREMUS & TARLOCK, *supra* note 11, at 69–70.

43. *See Natural Resources*, HOOPA VALLEY TRIBE, http://www.hoopa-nsn.gov/departments/natural-resources (last visited Jan. 7, 2015); *Natural Resources*, KARUK TRIBE, http://karuk.us/index.php/departments/natural-resources (last visited last visited Jan. 9, 2015); *Fisheries*, YUROK TRIBE, http://www.yuroktribe.org/departments/fisheries/FisheriesHome.htm (last visited Jan. 7, 2015) (all describing these tribal governance structures).

44. These agricultural communities depend on the water of the Klamath Basin to irrigate extensive cattle pasture, alfalfa, and other crops, including potatoes, horseradish, onions, and mint. WILLIAM S. BRAUNWORTH JR. ET AL., WATER ALLOCATION IN THE KLAMATH RECLAMATION PROJECT, 2001: AN ASSESSMENT OF NATURAL RESOURCE, ECONOMIC, SOCIAL, AND INSTITUTIONAL ISSUES WITH A FOCUS ON

eral policies[45] designed to attract and encourage settlement and land conversion for agricultural production. One such policy created the Bureau of Reclamation's Klamath Irrigation Project which supplies water to approximately 57% of the irrigable land in the Upper Basin,[46] providing "irrigation water to about 240,000 acres of croplands in southern Oregon and northern California, generally through contracts with both water districts and individual farmers; it also provides water for several National Wildlife Refuges."[47]

In addition to Bureau of Reclamation farmers in the Upper Basin, several other agricultural communities are critical to the dynamics of the Klamath Basin SES.These communities include "off project" ranchers and farmers who occupy the lands hydrologically "above" Upper Klamath Lake and depend on water from the Sprague, Williamson, and Wood River systems for irrigation; farmers and ranchers of the Scott and Shasta River valleys of northern California; and commercial fishing communities along the coast of Oregon, Washington, and parts of northern California that rely on the abundance of Klamath salmon to predict harvest quotas and season lengths.[48]Each basin community—tribal,agricultural, commercial fishing—figures prominently in the emergent legal and socio-political dynamics unfolding in the Basin over the last two decades, with significant bearing on the basin's resilience to external perturbation and potential for a regime shift.

C. Klamath Drivers, Disturbances, and Regime Shifts

This brief background on the Klamath SES sets the stage for an investigation of the nonlinear, cyclical trajectory that followed Euro-American settlement of the basin—characterized by a set of relatively slow controlling variables and punctuated by faster, acute shocks to the system, often emanating from different scales. The variables controlling the Klamath SES over the past century—private property rights, U.S. agrarian and irrigation policy, increased water use marginalizing Native Americans and culturally significant species, and the continual drying of the Upper Basin climate[49]—dynamically interacted giving rise to a rigid regime of environ-

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THE UPPER KLAMATH BASIN 231–50 (2003), *available at* http://extension.oregonstate.edu/catalog/html/sr/sr1037-e/report.pdf.

45. These policies are most strongly reflected in the various federal statutes that Congress enacted to encourage settlement in the West, from the various Homestead Acts to the Reclamation Act of 1902. *See* Homestead Act of 1862, ch. 75, 12 Stat. 392 (1862); Free Homestead Act, ch. 479, 31 Stat. 179 (1900); Reclamation Act of 1902, ch. 1093, 32 Stat. 388 (1902) (codified at 43 U.S.C. §§ 372–416).

46. Messier, *supra* note 37, at 526–27.

47. ROBERT W. ADLER ET AL., MODERN WATER LAW: PRIVATE PROPERTY, PUBLIC RIGHTS, AND ENVIRONMENTAL PROTECTION 634 (2013); *see also* DOREMUS & TARLOCK, *supra* note 11, at 47 ("The Klamath Basin was one of the first beneficiaries of the federal reclamation program . . . . Local residents petitioned for inclusion in the program when it was first established, and the Klamath Project was among the first wave of reclamation projects authorized in 1905.").

48. Spain, *supra* note 36, at 95–96.

49. U.S. DEP'T OF THE INTERIOR GEOLOGICAL SURVEY, PROCEEDINGS OF THE KLAMATH BASIN SCIENCE CONFERENCE 123–25 (Lyman Thorsteinson et al. eds., 2011), *available at* http://pubs.usgs.gov/of/2011/1196/pdf/ofr20111196.pdf; *see also Statement of Michael L. Connor, Commissioner, Bureau of Reclamation, U.S. Department of the Interior, Before the Energy and Natural Resources Committee U.S. Senate on Water Resource Issues in the Klamath River Basin*, U.S. DEP'T OF INTERIOR BUREAU OF RECLAMATION (June 20, 2013), http://www.usbr.gov/newsroom/testimony/detail.cfm?RecordID=2402 (testifying regarding the drying of the Klamath Basin and its potential effects).

mental governance favoring hydrologic modification, resource extraction, and general habitat degradation.The resulting system has been resilient to change, such that the introduction of additional, acute shocks to the system—implementation of the ESA, dam relicensing, increasing legal clout of Native Americans, and yearly droughts—have individually been unable to catalyze a regime shift, but collectively have laid the ground for a transformation in governance.

III. THE ADAPTIVE CYCLE IN THE KLAMATH BASIN SES

A characterization of the Klamath Basin in terms of the adaptive cycle provides a heuristic mechanism for analyzing the historical trajectory of resilience in the basin SES, but it also becomes a device to "give sense to what might be"—a tool for describing the current state of the Klamath Basin SES and for identifying past and potential future thresholds in both the social and ecological components of the system.[50] The concept of the adaptive cycle was forwarded by Gunderson and Holling in an effort to describe a *cycle* of adaptive change—birth, growth, maturation, death, and renewal—as opposed to a more linear succession in SESs.[51] The phases of the adaptive cycle are formally termed conservation, exploitation, release, and reorganization. These phases describe the productivity of complex systems and a constant interaction between stabilizing and destabilizing forces acting upon SESs.[52] In this sense, the adaptive cycle is a model that provides insight into dynamic connectedness (of internal controlling variables), potential (for change), and *resilience* of the system over time.[53]

However, the adaptive cycle is only one piece of the complex puzzle that describes the property of resilience in SESs. Adaptive cycles manifest in hierarchies, with faster, smaller-scale cycles nested into slower, larger-scale cycles of system change.[54]These nested cycles are not *controlled* hierarchically or "top down" in the traditional sense of the word. Instead,the nested cycles impose a series of constraints and opportunities during times of dynamic change (such as during the reorganization phase) with interconnected cycles operating at both larger and smaller scales than the particular SES being studied. These cross-scale interactions[55] are critical to understanding the complex relationships between ecology, social dynamics, and law at the basin-scale of the Klamath SES. In the remainder of this section, we present a narrative history of the Klamath Basin SES, told through the various phases of the adaptive cycle, and mindful of the importance of nested systems and cross-scale interactions to the dynamic nature of environmental governance in the basin.

50. GUNDERSON & HOLLING, *supra* note 5, at 32–33.
51. *See id.*
52. *Id.* at 27–33.
53. *Id.* at 33–43 (emphasis added).
54. *Id.* at 72–76.
55. An idea termed "panarchy" by Gunderson and Holling. *Id.* at 74.

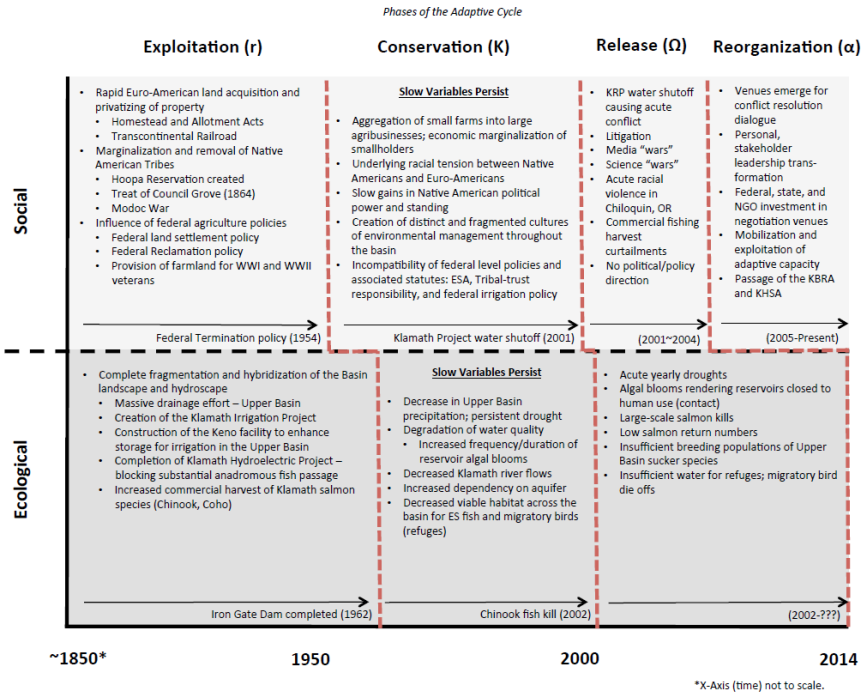

FIGURE 2. Historical Adaptive Cycle Narrative of the Klamath Basin (1850-present)

A. Exploitation Phase (r)

While somewhat arbitrary, we begin our narrative with the settlement of the Klamath Basin by Euro-Americans, a time period characterized by the swift extraction and exploitation of natural resources, the fragmentation and hybridization of hydrologic landscape processes, the institutionalization of a system of private property rights, and the forced marginalization of indigenous peoples. A detailed exploration of this phase aids in the identification of slow, controlling variables in the system, such as U.S. agrarian and Native American tribal-trust policy, that dynamically interact during subsequent phases of conservation, release, and reorganization.

A series of early settlement acts enabled the trajectory of manifest destiny and escalated tensions between encroaching settlers and Native American residents to the point of violence in the Klamath Basin.[56] Tribal land bases in both the upper and lower parts of the basin were reduced to reservations representing fractions of original indigenous territory[57] and later, the General Allotment Act of 1887 ended

56. One example would be the Modoc War. *See* MOST, *supra* note 11, at 25–26, 32–40.

57. Treaty between the United States of America and the Klamath and Modoc Tribes and Yahooskin Band of Snake Indians, U.S.-Klamath and Modc tribes and Yahooskin Band of Snake Indians, art. I, Oct. 14, 1864, 16 Stat. 707; *see also* Donnelly v. United States, 228 U.S. 243, 254 (1913) ("[e]xtension of the Hoopa Valley Reservation was made by executiveorder of President Harrison, dated October16, 1891").

communal tribal ownership of reservation land and granted parcels to individual Indians in fee. Over time, many of these allotments passed into non-Indian ownership, further compromising tribal sovereignty.

This marginalization precipitated racial tension that would persist as an underlying system variable, surfacing throughout the phases of the Klamath Basin adaptive cycle to decrease the SES's resilience to external shocks.

A combination of coinciding events, including the rapid settlement of the nearby Rogue Valley, the Applegate Trail (a spur of the Oregon Trail running through the basin), and the California Gold Rush, brought an abundance of white settlers to the basin and precipitated the founding of Linkville in 1867 at the site of present day Klamath Falls.[58]It is at this point that federally funded hydrologic modification began in the basin.

1.Reclamation Act of 1902 and the Klamath Irrigation Project

As Holly Doremus and Dan Tarlock have noted, "[t]he Upper Klamath Basin, high, cold, and dry in the summer, had little value for agriculture in the absence of irrigation."[59]As such, settlement involved the development of significant infrastructure, beginning in 1882.[60]At the federal level, the primary legal mechanism for authorizing and funding large irrigation, or "reclamation," projects in the West has been the Reclamation Act of 1902.[61]

The Klamath Irrigation Project, one of the earliest reclamation projects,[62] was authorized under the Act in 1905 and accelerated the exploitation of natural capital (ecological goods and services) in the Upper Basin by facilitating the reclamation of swamps and lakes to increase irrigable acres.[63]With the State of Oregon's cooperation, the United States, acting through the Bureau of Reclamation, appropriated all available water in the Klamath River, the Lost River, and their tributaries for the project.[64] Construction of the Project's East Canal began in 1906; however, the Klamath Project was not fully completed until the 1960s.[65]Throughout most of the first half of the 20th century, intense drainage and construction of irrigation infra-

58. MOST, *supra* note 11, at 30–32.

59. DOREMUS & TARLOCK, *supra* not 11, at 37.

60. *Klamath Project*, U.S. BUREAU OF RECLAMATION, http://www.usbr.gov/projects/Project.jsp?proj_Name=Klamath+Project (last visited Jan. 9, 2015).

61 The Act created what was initially known as the Reclamation Service (now the U.S. Bureau of Reclamation) and authorized the agency to carry out projects for the reclamation of the arid lands in 17 western states, including California and Oregon. 43 U.S.C.A. § 373 (West 2014). The Act's original agricultural focus is still evident in its definition of "project," which is "a Federal *irrigation* project authorized by the reclamation law." 43 U.S.C.A. § 371(d) (West 2014) (emphasis added).

62. ADLER ET AL., *supra* note 47, at 634; *see also* DOREMUS & TARLOCK, *supra* note 27, at 47 ("The Klamath Basin was one of the first beneficiaries of the federal reclamation program . . . . Local residents petitioned for inclusion in the program when it was first established, and the Klamath Project was among the first wave of reclamation projects authorized in 1905.").

63. *See* 443 U.S.C.A. § 373–475 (West 2014).

64. ADLER ET AL., *supra* note 47, at 634.

65. The headgates of the East Canal were not completed until 1907. Project dams soon followed: the Lost River Dam, the Gerber Dam, and the Miller Diversion Dam. DOREMUS & TARLOCK, *supra* note 11, at 48–50.

structure continued in the Upper Basin under the auspice of the Project, encouraging increased white settlement and population growth.[66]

The Reclamation Act exemplifies the Jeffersonian ideal of the yeoman farmer that permeated U.S. public policy throughout the late 19th and early 20th centuries, encouraging citizens to move west in search of arable land.[67]To further this policy, after both World War I and World War II, the United States offered tracts of lands to veterans returning from war as a "thank you" for service.[68]In making these grants, the United States essentially publicly recognized agriculture as a patriotic pursuit and further established farming, ranching, and associated private property rights institutions as major controlling variables in the Klamath Basin SES. Indeed, members of the Klamath Water Users Association, the irrigators who use Klamath Project water, have long been and remain today among the most politically powerful people in the basin.[69]

2. Hydroelectricity in the Basin and the Klamath River Basin Compact of 1957

The arrival of railroads to the region increased the viability of extractive industries such as logging and mining, which in turn spurred the need for electricity. Early provision of hydroelectricity in the Klamath Basin began in 1882 with a small diversion project and water wheel near Klamath Falls, Oregon.[70] Over the next 30 years the California Oregon Power Company ("COPCO") consolidated the majority of independent, small infrastructure projects, and began construction of the first mainstem Klamath River hydroelectric dam in 1909.[71]Between the construction on that facility (the Copco 1 Dam) and the completion of Iron Gate Dam in 1964, COPCO oversaw the consolidation of power generation and infrastructure projects throughout the region, culminating in the licensing of seven generation facilities by the Federal Energy Regulatory Commission (FERC) in 1956 under the Klamath Hydroelectric Project.[72]As dictated by the Federal Power Act, the Project would need to be relicensed after 50 years. At present, Keno Dam regulates the outflow of water from the Upper Basin into the mainstem Klamath River, and four power generation facilities fragment the river between Klamath Falls, Oregon, and Yreka, California, blocking passage of anadromous fish and creating large reservoirs.[73]

The expansion of hydroelectricity generation in the Klamath Basin and claims by COPCO to unappropriated water triggered the negotiations between Oregon and

66. DRAFT KLAMATH EIS/EIR, *supra* note 23, at ES-8 to -9.

67. *See* 43 U.S.C.A. § 373–475 (West 2014)

68. Most, *supra* note 11, .

69. Gosnell & Kelly, *supra* note 23, at 377–80.

70. GEORGE KRAMER, KLAMATH HYDROELECTRIC PROJECT 2–4 (2003), *available at* http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Hydro/Hydro_Licensing/Klamath_River/Appendix_E_6D_Historic_Context.pdf

71. *Id.* at 19.

72. *Id.* at 28.

73. *Klamath River*, PACIFICORP, http://www.pacificorp.com/es/hydro/hl/kr.html (last visited Jan. 12, 2015).

California that created the Klamath Basin Compact,[74]today one of numerous such compacts that exist throughout the country to govern interstate water resources and their allocations.[75]Congress approved the Klamath Basin Compact on August 30, 1957.[76] The compact protects all vested rights and the operation of the Klamath Basin Project,[77] and it prohibits almost all diversions out of the Upper Klamath Basin.[78] As Doremus and Tarlock have summarized:

> The Klamath River Basin Compact . . . gave the Upper Basin irrigators everything they wanted. It confirmed all vested rights to waters originating in the Upper Klamath Basin, defined as above the state boundary. It guaranteed that future irrigation of up to 100,000 acres in California and 200,000 acres in Oregon would have priority over hydroelectric power generation and in general placed domestic and irrigation use over all other beneficial uses.[79]

However, the compact also specified that it did not affect either tribal or the United States' water rights in the system.[80] The negotiation of the Klamath River Basin Compact—under circumstances that appeared to pit irrigators against hydroelectric power while underestimating the significance of the legal rights retained by the Tribes—played an important part in the early basin dynamics of human conflict over water and foreshadowed interactions between resource allocation and law that would serve to lessen basin resilience over time.[81]

Ecologically, the exploitation phase of the Klamath Basin adaptive cycle culminated with the completion of Iron Gate dam in 1962—the final major fragmentation of the Klamath River system. Socially, however, the Klamath Basin SES seemed to enter a phase of "conservation"[82] after the"termination"[83] policy of the

74. DOREMUS & TARLOCK, *supra* note 11, at 42. Interstate compacts are allowed under the U.S. Constitution, which declares that "[n]o state shall, without the Consent of Congress . . . enter into any Agreement or Compact with another State, or with a foreign Power." U.S. CONST. art. I, § 10, cl. 3.

75. ADLER ET AL., *supra* note 47, at 477–84.

76. Act of Aug. 30, 1957, Pub. L. No. 85-222, 71 Stat. 497.

77. Act of Aug. 30, 1957, Pub. L. No. 85-222, 71 Stat. 498–99.

78. Act of Aug. 30, 1957, Pub. L. No. 85-222, 71 Stat. 499.

79. DOREMUS & TARLOCK, *supra* note 11, at 43.

80. Act of Aug. 30, 1957, Pub. L. No. 85-222, 71 Stat. 497 505–06.

81. *See* DOREMUS & TARLOCK, *supra* note 11, at 42–43 (discussing how COPCO claimed that there was unappropriated water available for hydropower, spurring "[u]pper Basin irrigators, supported by the United States, [to take] the traditional position, a legacy of the progressive conservation era, that any power development should be both public and subordinate to irrigation").

82. GUNDERSON & HOLLING, *supra* note 5, at 32–35.

83. According to the lawyer and historian Charles Wilkinson:

> [O]n August 1, 1953, Congress . . . activat[ed] the most extreme Indian program in history. House Concurrent Resolution 108 officially announced the termination policy, a "final solution" that would lead to a sell-off of tribal lands, the withdrawal of all federal support, and the rapid assimilation of Indian people into the majority society. Advocates for termination asserted that many tribes were self-sufficient (and thus ready for termination) and that the others would be ready within a short period of time.
>
> This theory had no basis in the reality of Indian country. Far from being self-sufficient, poverty-stricken Indian people hung on mainly because of meager federal support and the sustenance they could gain from the land. For Indian tribes, virtually nothing could be more threatening to these place-based peoples than the expropriation of their land.

1950s eliminated the legal status and a majority of the land base of the Klamath Tribes of the Upper Basin in 1954.[84]It was this poignant marginalization of native Klamath peoples that solidified the entrenched status quo of Euro-American agriculture (farming, ranching, and commercial fishing) as the dominant political and economic drivers in the basin.[85]This dynamic highlights the important interplay between communities nested within the Klamath Basin SES experiencing different phases of the adaptive cycle simultaneously but in fundamentally different ways. For example, in contrast to the white settlers, for whom the transition between the exploitation and conservation phase marked a period of stability and prosperity, the Klamath Tribes experienced the growing "stability" of the conservation phase as a solidification of their marginalization and a slow decline into a release after the 1954 termination of their tribal status. While in this paper we focus on the adaptive cycle as it manifested at the scale of the Klamath River Basin, it is important to recognize that an analysis of relevant nested adaptive cycles at larger and smaller scales helps identify the cross-scale dynamics that drive basin-scale change. For example, just as the cross-scale interactions among federal Indian policy, regional reclamation policy, and local social and economic realities in the early 20th century influenced the distribution of political and economic power within the Basin during the exploitation phase, the emergence of national-scale environmental and civil rights laws and policies in the late 20th century and concurrent re-envisioning of tribal rights became important cross-scale drivers of change in the Basin during later phases.

B. Conservation Phase (K)

During the conservation phase, slow system variables control the SES trajectory. Although characteristics of the exploitation phase still persist, less rapid exploitative change occurs. In addition, a system in conservation shows a remarkable amount of resilience to disturbance at first, but over time the interaction of slow controlling variables can increase the vulnerability of an SES to rapid change in response to disturbances, making it much more likely that the SES could collapse when perturbed.[86]

From roughly the mid-20th century to the dawn of the 21st in the Klamath River Basin, exploitation of resources continued to persist (although at a slower pace) through the incremental diking, draining and damming of the Klamath River system; the increase in basin population, which caused a further strain on natural resources; and the fragmentation in resource management as federal, state, local, and tribal agencies became more compartmentalized and competed for jurisdiction,

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CHARLES WILKINSON, BLOOD STRUGGLE: THE RISE OF MODERN INDIAN NATIONS xiii (2005). For many tribes, termination seemed to be the final blow in a losing battle to preserve their culture. Many believed that the U.S. government was trying to literally erase Indians from the map of the United States. Michael C. Walch, *Terminating the Indian Termination Policy*, 35 STAN. L. REV. 1181, 1183–89 (1983).

84. Under the larger federal policy direction known as "termination," the Klamath tribes' (Klamath, Modoc, and Yahooskin Snake) legal status as a tribal entity was removed in 1954 and all reservation lands were seized by the federal government under a negotiated settlement with the Unites States. Act of Aug. 13, 1954 ,Pub. L. No. 587, 68 Stat. 718, (codified as amended at 25 U.S.C. § 564); *see also* DOREMUS & TARLOCK, *supra* note 11, at 63–65.

85. DOREMUS & TARLOCK, *supra* note 11, at 63–65.

86. GUNDERSON & HOLLING, *supra* note 5.

authority, and power.[87]The intensification of land use, including a 1967 Act of Congress[88] that permitted farming on the Lower Klamath National Wildlife Refuge (NWR), led to an increase in nutrient runoff entering Upper and Lower Klamath Lake and flowing downstream through the Klamath Hydroelectric Project.[89]The persistent low, static flows (relative to the historic seasonally variable flows) in the mainstem Klamath River through the Project's reach, combined with increased nutrient inputs, led to significant toxic cyanobacteria blooms that increased in frequency and duration during the conservation phase.[90]Algal blooms often caused officials to close reservoirs to human contact recreation and increased the mortality rate for returning salmon species downstream of Iron Gate Dam.

Climatically, a decrease in precipitation (which also came increasingly as rain instead of snow) across the arid upper portions of the basin, combined with earlier timing of snowmelt and runoff, caused acute droughts and placed significant pressure on established agriculture.[91]Upper Basin farmers and ranchers initiated or increased groundwater pumping, taxing surrounding aquifers in order to maintain crop productivity levels.[92]In addition, droughts decreased the volume and quality of water available for in-lake storage and river flow, raising river temperatures and decreasing the amount of viable habitat available for the culturally significant Lost River and shortnose sucker and coho salmon.[93]

C.The "Late K Phase"

As the overexploited system began to demonstrate signs of vulnerability, two converging trends put an additional squeeze on the system: the growing recognition of tribal water rights in the Upper Basin beginning in the 1970s, and the passage of the Endangered Species Act in 1973. Together, these cross-scale interactions from larger-scale (national and global) adaptive cycle dynamics—culminating in the Klamath Basin in the listing of the Lost River and shortnose suckers in 1988 as endangered and the coho salmon in 1997 as threatened—created a legal rigidity that signified the beginning of the "late K phase" in the basin—the point in the conservation phase at which efficient systems start to show signs of weakness and vulnerability.

1.Legal Recognition of Indian Water Rights

Although the Treaty of 1864 established a legal basis for the Klamath Tribes' water rights, they received no formal recognition for over a century. However, a series of court cases beginning in the 1970s in the Columbia Basin and then later in the Klamath Basin began to reveal the true meaning of "hunting and fishing treaty

87. Chaffin, *supra* note 8, at 92-10; *see also* DRAFT KLAMMATH EIS/EIR, *supra* note 23, at Vol. 1 ES-1–9.

88. Act of Sept. 2, 1964, Public Law 88-567, 78 Stat. 850.

89. *Id.* at Vol. 2 C-1-106..

90. *Id.*

91. U.S. DEP'T OF THE INTERIOR GEOGRAPHICAL SURVEY, *supra* note 49, at 123–125.

92. Tara Jane Campbell, Klamath Reclamation Project: Approaches to Sustainable Groundwater Management (2013)(unpublished masters of natural resources project, Oregon State University).

93. 2008 NRC KLAMATH HYDROLOGY REPORT, *supra* note 21, at 214–62.

rights" and what they implied for irrigators with water rights under states' prior appropriation doctrines.[94]In 1983, the U.S. Court of Appeals for the Ninth Circuit upheld Klamath Basin tribal water claims, at least with respect to the Williamson River sub-watershed in the Upper Basin.[95] Specifically, the Ninth Circuit upheld the district court's award of two sets of federal reserved water rights to the Klamath Tribes: traditional *Winters* rights for tribal agriculture, and reservations of water "for the purpose of maintaining the Tribe's treaty right to hunt and fish on reservation lands."[96] The court acknowledged that "the right to water reserved to further the Tribe's hunting and fishing purposes is unusual in that it is basically non-consumptive. . . . Rather, the entitlement consists of the right to prevent other appropriators from depleting streamflow below a protected level in any area where the non-consumptive right applies."[97] As a result, the court effectively awarded the Tribes the right to an instream flow for the fish—a right to keep water in streams. Moreover, because the water right derived from the 1864 treaty, which in turn recognized the Tribes' aboriginal water rights, those "water rights necessarily carry a priority date of time immemorial."[98] Thus, the Ninth Circuit recognized in the Tribes a high priority water right that could effectively be employed to help preserve the ecological systems of the Klamath Basin SES. In addition, a variety of other legal mechanisms have been used to protect, or attempt to protect, the Tribes' interest in the basin's water, its fish, and its wildlife.[99]

It is worth noting again that tribal and non-tribal experiences of the conservation phase (and "the late K phase" in particular) were both intricately linked and in diametric opposition. As the irrigators' strong sociopolitical position became increasingly tenuous with growing recognition of tribal water rights and the needs of endangered species, the Tribes' political power and potential for improved conditions grew. Both communities were moving toward the release phase, with release signifying significantly different fates.

2. Endangered Species Act of 1973 and the Listing of Klamath Species

Nothing has underscored the fragility of the Klamath Basin SES more than the application of the federal ESA[100] to three species of the basin's fish. The ESA's

94. *See, e.g.*, United States v. Adair, 723 F.2d 1394 (9th Cir. 1983).
95. *Id.* at 1404.
96. *Id.* at 1410.
97. *Id.* at 1411.
98. *Id.* at 1414.
99. For example, in 1995, the Ninth Circuit upheld the Secretary of Commerce's 1993 decision to reduce ocean commercial harvest of Klamath River Chinook salmon in order to preserve tribal reserved fishing rights in the Klamath River. Parravano v. Babbitt, 70 F.3d 539, 541–42 (9th Cir. 1995). In contrast, about a decade later, the Hoopa Valley Tribe asked the Federal Energy Regulatory Commission to impose conditions on PacifiCorp's Klamath Hydroelectric Project to protect the Klamath River trout fishery, but it lost both before the agency and in court. Hoopa Valley Tribe v. FERC, 629 F.3d 209, 210–13 (D.C. Cir. 2010). More recently, the Klamath Tribe Claims Committee filed suit in the U.S. Court of Federal Claims seeking damages against the federal government based on the Department of the Interior's breaches of its fiduciary duty, failure to pay money owed to the Tribes, and failure to safeguard the Tribes' treaty-based water rights. However, the Klamath Tribes refused to join the case, and the case was dismissed on grounds that the Klamath Tribes was an indispensable party. *Id.*
100. Endangered Species Act of 1973, 16 U.S.C.A. §§ 1531–1544 (West 2012) (Congress enacted the ESA in 1973 "to provide a means whereby the ecosystems upon which endangered species and

protections do not apply until one of the implementing agencies—the U.S. Fish & Wildlife Service ("USFWS") or the National Marine Fisheries Service ("NMFS")—actively lists a species under Section 4.[101]As such, species listing is a type of cross-scale perturbation from the national scale into more regional and local water governance that can disturb the relative stability of an SES in the conservation phase. In the Klamath River Basin, as noted, three species of fish are currently listed for protection under the ESA: the Lost River Sucker, listed as an endangered species by the USFWS in 1988;[102] the shortnosed sucker, listed as an endangered species by the USFWS in 1988;[103] and the Southern Oregon/Northern California coastal coho salmon, listed as a threatened species by NMFS in 1997.[104]

Because the Bureau of Reclamation, a federal agency, operates the Klamath Project, the ESA's Section 7 consultation process applies to the project's operations.[105] During this process, the relevant Service—USFWS for the suckers, NMFS for the coho—produces a formal Biological Opinion 1) stating its conclusions as to whether the proposed action will jeopardize any species or damage or destroy its critical habitat and 2) suggesting reasonable and prudent alternatives ("RPAs") if

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threatened species depend may be conserved" and "to provide a program for the conservation of such endangered species and threatened species").

101. *See* § 1533. Acting on behalf of the Secretary of the Interior, the USFWS has jurisdiction over terrestrial and freshwater species, while NMFS, acting on behalf of the Secretary of Commerce, has jurisdiction over marine and anadromous species. *See* § 1532(15) (defining "Secretary" and referencing the Reorganization Plan that divides agency responsibilities as stated). "The Secretary shall make decisions . . . solely on the basis of the best scientific and commercial data available." § 1533(b)(1)(A).The appropriate Service will list a species for protection under the ESA if it qualifies as an endangered species or a threatened species because of at least one of five factors. The factors are:

> [T]he persistent or threatened destruction, modification, or curtailment of its habitat or range . . . overutilization for commercial, recreational, scientific, or educational purposes . . . disease or predation … the inadequacy of existing regulatory mechanisms;or . . . other natural or manmade factors affecting its continued existence.

§ 1533(a)(1).

102. Or. Fish & Wildlife Office, *Species Fact Sheet: Lost River Sucker*, U.S. FISH & WILDLIFE SERVICE, http://www.fws.gov/oregonfwo/species/Data/LostRiverSucker/ (last updated Apr. 16, 2008)

103. Or. Fish & Wildlife Office, *Species Fact Sheet: Shortnose Sucker*,U.S. FISH & WILDLIFE SERVICE, http://www.fws.gov/oregonfwo/Species/Data/shortnosesucker/ (last updated Apr. 16, 2008)

104. Office of Protected Res.,NAT'L MARINEFISHERIES SERVICE, http://www.nmfs.noaa.gov/pr/species/fish/cohosalmon.htm (last updated May 15, 2014).

105. Specifically:

> Each Federal agency shall, in consultation with and with the assistance of the [expert agencies], insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an "agency action") is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined . . . to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section. In fulfilling the requirements of this paragraph the agency shall use the best scientific and commercial data available.

16 U.S.C.A. § 1536(a)(2) (West 2012). The USFWS's and NMFS's joint regulations for Section 7 define "[j]eopardize the continued existence of" to mean "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." 50 C.F.R. § 402.02 (2013).

necessary to avoid violating Section 7(a)(2).[106] While individual irrigators and other water users in the Klamath Basin could potentially also become liable under Section 9 of the ESA if they "take" fish listed for protection,[107]it was Section 7 Biological Opinions (and responses to them) that provided the initial disruptive force to initiate the Klamath Basin's release phase.

The listing of the three fish under the ESA in 1988 and 1997 highlights two important forcing factors mounting during the Klamath conservation phase: the relevance of the 1960s and 1970s environmental legislation and a shift in the legal and political standing of the basin Tribes. The ESA, Clean Water Act,[108]National Environmental Policy Act ("NEPA"),[109]and other statutes legitimized a public will to conserve endangered species, protect water quality, and to involve citizens in environmental decision-making. In addition, for the first time since Euro-American contact, the Tribes of both the Upper and Lower Basin found an ally in the U.S. court system and initiated a quest for quantification of water rights and fishing rights to protect and eventually harvest culturally significant fish species.

Towards the end of the conservation period, the ESA and supporting fisheries science put pressure on the status quo of water management in the basin. Specifically, Biological Opinions recommended lake levels and river flows sufficient to protect suckers and coho that did not match the operating procedures of the Klamath Reclamation Project. As a result, the Bureau of Reclamation curtailed water deliveries from the Klamath Project, rendering roughly 1,400 farms and 210,000 acres[110] of cropland without water, causing social unrest and signaling a phase shift in the Klamath SES.

D. Release Phase (Ω)

It is apparent that by April 2001 the Klamath Basin SES had entered a period of release. The release phase is chaotic—"[a]ccumulated resources are released from their bound, sequestered, and controlled state, connections are broken, and feedback regulatory controls weaken."[111]The controlling variables of the system were too densely connected to one another, meaning that the failure of one would undoubtedly cause collapse in the entire system. In particular, governance of the basin's resources had become rigid and vulnerable to external disturbances and internal failures—both of which happened in 2001. In this section we examine more closely the ecological, legal and political factors that precipitated a release in the system.

1.Upper Basin Water Curtailment in 2001

As Doremus and Tarlock have described in detail, the tensions between protection of aquatic species like the coho and human water users' dependence on the Project reached a crisis point in 2001 when the Bureau of Reclamation refused to

106. 16 U.S.C.A. § 1536(b) (West 2012).
107. 16 U.S.C.A. § 1538 (West 2012).
108. Clean Water Act, 33 U.S.C.A. §§ 1251–1387 (West 2012).
109. National Environmental Policy Act, 42 U.S.C.A. §§ 4321–4370h (West 2012).
110. DOREMUS & TARLOCK, *supra* note 11, at 2.
111. GUNDERSON & HOLLING, *supra* note 5, at 45.

deliver water to farmers and ranchers in order to comply with the ESA.[112] The Bureau's decision to close the headgates of the Klamath Project in 2001 responded to an April 2001 injunction from the U.S. District Court for the District of Northern California.[113]

Almost immediately after that decision, the Bureau of Reclamation released its 2001 Annual Operations Plan for the Klamath Project,[114] incorporating minimum instream flows that NMFS recommended to avoid jeopardizing the coho.[115] Irrigators and other water users sued to enjoin implementation of the plan on the grounds that the plan would give too much water to the fish.[116] In an opinion issued April 30, 2001, the Oregon Federal District Court refused to enjoin the plan.[117] It

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112. Specifically:

> After simmering for a decade, the tension between irrigation and species conservation came to a head during the exceptionally severe drought summer of 2001. For the first time in its history, the United States Bureau of Reclamation was forced to make an absolute choice between irrigation deliveries and species conservation. Believing that the law left it no choice, the Bureau closed the headgates of the Klamath Project to comply with its conservation duties under the Endangered Species Act . . . .

DOREMUS & TARLOCK, *supra* note 11, at 1.

113. Pac. Coast Fed'n of Fishermen's Ass'ns v. U.S. Bureau of Reclamation, 138 F. Supp. 2d 1228, 1248–49 (N.D. Cal. 2001). Specifically, the court enjoined the Bureau of Reclamation

> from sending irrigation deliveries from Klamath Project whenever Klamath River flows at Iron Gate Dam drop below the minimum flows recommended in the Hardy Phase I report, until such time as the Bureau completes a concrete plan to guide operations in the new water year, and consultation concerning that plan is completed, either by (1) formal consultation to a 'no jeopardy' finding by the NMFS, or (2) the Bureau's final determination, with the written concurrence of the NMFS, that the proposed plan is unlikely to adversely affect the threatened coho salmon.

Id. at 1250.

114. Kandra v. United States, 145 F. Supp. 2d 1192, 1198–99 (D. Or. 2001).

115. *Id.* More specifically, in response to the Bureau's initial proposal, "FWS and NMFS again concluded that operation of the Project, as initially proposed by Reclamation, would jeopardize the continued existence of the suckers and the coho salmon." *Id.* at 1198. As a result,

> NMFS proposed a range of minimum instream flows in the Klamath River below Iron Gate Dam from April through September, from a low of 1,000 cubic feet per second ("cfs") in July through September, to a high of 2,100 cfs between June 1–15. The river flows are recommended in order to increase riparian habitat for coho salmon.

Id. at 1198–99.

116. *See id.* at 1195–96 (stating "Under the 2001 Plan, water elevations of Upper Klamath Lake and water flows below Iron Gate Dam will be maintained to support endangered sucker fish and threatened coho salmon. Due to inadequate water supplies, no irrigation water deliveries will be made to the majority of land within the Klamath Reclamation Project . . . .").

117. In its prescient conclusion, the court emphasized that:

> In essence, plaintiffs request that this court stand in the place of Reclamation as the operator of the Project and reallocate Project water in a manner that is inconsistent with governing law. Plaintiffs fail to show a likelihood of success on the merits of their claims, and, more importantly, plaintiffs fail to establish that they are entitled to the injunctive relief they seek. While the court sympathizes with plaintiffs and their plight, I am bound by oath to uphold the law. The law requires the protection of suckers and salmon as endangered and threatened species and as tribal trust resources, even if plaintiffs disagree with the manner in which the fish are protected or believe that they inequitably bear the burden of such protection.
>
> The scarcity of water in the Klamath River Basin is a situation likely to reoccur. It is also a situation which demands effort and resolve on the part of all parties to create solutions that

was now clear in the Basin that the water needs of listed fish would recurrently disturb human water users' expectations for water availability, redistributing legal and political power in the system to the environmental and tribal interests that wanted both to protect the fish and more generally to keep more water in the river system.

2. Moves and Countermoves, 2001-2004

The summer of 2001 did not end the Klamath Basin controversy or the litigation. The Departments of the Interior and of Commerce commissioned the National Research Council to review the science underlying the 2001 Biological Opinion.[118] The Committee issued its report in February 2002, concluding that there was no scientific support for the USFWS's and NMFS's minimum stream flow requirements.[119]Soon thereafter, the Bureau of Reclamation issued a 10-year Operations Plan for the Klamath Project to govern water deliveries from 2002 to 2012, and the plan promised to satisfy the needs of all water users in the system through the creation of a "water bank."[120] The plan and the Biological Opinion supporting it were immediately challenged in court; in addition, inauspiciously for the federal government, "33,000 chinook, coho, and steelhead salmon died in an unexplained fish kill in the Klamath River between September 20 and 27, 2002 . . . ."[121] In 2005, the Ninth Circuit invalidated the first two phases of the Operations Plan governing 2002-2008, and remanded to the district court for appropriate injunctive relief.[122] The resulting injunction lasted well into 2007, expiring only on the completion of a new Biological Opinion.[123]

> provide water for the necessary protection of fish, wildlife and tribal trust resources, as well as the agricultural needs of farmers and their communities. Continued litigation is not likely to assist in such a challenging endeavor. This court hopes and expects that the parties and other entities necessary to long-term solutions will continue to pursue alternatives to meet the needs of the Klamath River Basin.

Id. at 1211.

118. DOREMUS & TARLOCK, *supra* note 11, at 121.

119. *Id.* at 122–23.

120. *Id.* at 124.

121. Pac. Coast Fed'n of Fishermen's Ass'ns v. U.S. Bureau of Reclamation, 426 F.3d 1082, 1089 (9th Cir. 2005). The fish kill was eventually explained as a crowding event, where low flows caused a depletion of oxygen and the spread of disease at lethal levels. CAL DEP'T OF FISH & GAME, SEPTEMBER 2002 KLAMATH RIVER FISH-KILL: FINAL ANALYSIS OF CONTRIBUTING FACTORS AND IMPACTS 11–13, 74–82 (2004), *available at* http://www.pcffa.org/KlamFishKillFactorsDFGReport.pdf.

122. *Pac. Coast Fed'n*, 426 F.3d at 1094–95.

123. In March 2006, the Northern District of California, on remand, issued the required injunction. Pac. Coast Fed'n of Fishermen's Ass'ns v. U.S. Bureau of Reclamation, No. 02-2006, 2006 WL 798920 (N.D. Cal. Mar. 27, 2006). It ordered NMFS and the Bureau of Reclamation to re-initiate consultation under Section 7 of the ESA; ordered NMFS to produce a new Biological Opinion; and required the Bureau of Reclamation

> to limit Klamath Project irrigation deliveries if they would cause water flows in the Klamath River at and below Iron Gate Dam to fall below 100% of the Phase III flow levels specifically identified by NMFS in the Biological Opinion as necessary to prevent jeopardy, Biological Opinion at 70 (Table 9), until the new consultation for the Klamath Irrigation Project is completed and reviewed by this Court.

The water delivery crisis of 2001 also spawned a protracted set of lawsuits by the water users. Specifically, despite the fact that irrigators received about $40 million in state and federal disaster aid as a result of the 2001 drought,[124] "13 agricultural landowners and 14 water, drainage, and irrigation districts" affected by the lack of water deliveries sued the United States for damages, alleging that the United States had breached their water contracts, violated the Klamath Basin Compact, and unconstitutionally taken water rights without compensation.[125] In 2005, the U.S. Court of Federal Claims dismissed the takings claims on the grounds that the plaintiffs asserted only breach of contract claims.[126] Two years later, it also dismissed the breach of contract claims.[127] On appeal, however, in 2011 the U.S. Court of Appeals for the Federal Circuit remanded for reconsideration after certifying questions of state property law to the Oregon Supreme Court.[128] In November 2013, the Court of Federal Claims dismissed claims by the Klamath Irrigation District, the Tulare Irrigation District, and Mr. Lon Baley for lack of subject matter jurisdiction,[129] but it also concluded that it had jurisdiction to decide the other 11 plaintiffs' claims.[130] That litigation continues.

3. Shocks and Triggers: Changing Legal and Social-Ecological Interactions in the Klamath Basin, 2004-2006

The events of 2001-2002 triggered a set of threshold dynamics[131] involving legal, social, and ecological variables—the incompatibility of U.S. agrarian, irrigation, environmental, and tribal-trust policy; underlying tensions of racial marginalization; over-allocation of water resources; and ecological degradation—that had

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Id. at *7–8. In May 2006, the district court amended its order so that the injunction expired on the completion of a new Biological Opinion. Pac. Coast Fed'n of Fishermen's Ass'ns v. U.S. Bureau of Reclamation, No. 02-2006, 2006 WL 1469390, at *9 (N.D. Cal. May 25, 2006). The Ninth Circuit affirmed the injunction in late March 2007. Pac. Coast Fed'n of Fishermen's Ass'ns v. U.S. Bureau of Reclamation, 226 F. App'x 715, 718 (9th Cir. 2007).

124. ADLER ET AL., *supra* note 47, at 635.

125. *Klamath Irrigation Dist.*, 67 Fed. Cl. at 507, 514.

126. *Id.* at 540.

127. *See* Klamath Irrigation Dist. v. United States, 75 Fed. Cl. 677, 683–85 (Fed. Cl. 2007). Notably, the Ninth Circuit had already decided in 1999 that the Klamath Water Users Protective Association and other irrigators in the Klamath Basin were not third-party beneficiaries to a 1956 contract between the United States Bureau of Reclamation and the COPCO that governs the management of the Link River Dam in the Klamath Basin. Klamath Water Users Protective Ass'n v. Patterson, 204 F.3d 1206, 1209 (9th Cir. 1999).

128. Klamath Irrigation Dist. v. United States, 532 F.3d 1376 (Fed. Cir. 2008); *see also* Klamath Irrigation Dist. v. United States, 635 F.3d 505, 507–08 (Fed. Cir. 2011). The Oregon Supreme Court accepted certification in 2009, Klamath Irrigation Dist. v. United States, 202 P.3d 159 (Or. 2009), and on March 11, 2010, it issued an *en banc* decision answering all three questions that the Ninth Circuit posed. Klamath Irrigation Dist. v. United States, 227 P.3d 1145 (Or. 2010) (en banc). According to the Oregon Supreme Court, the fact that the U.S. Bureau of Reclamation/federal government holds the state appropriative water rights for the Klamath Basin Project does *not* preclude the persons actually putting the water to beneficial use from acquiring a property interest in the water. *Id.* at 37. However, because the court did not have all the relevant Bureau of Reclamation contracts before it, it could not decide whether the users of Klamath Basin Project water actually had property rights in that water. *Id.* at 51–52.

129. Klamath Irrigation Dist. v. United States, 113 Fed. Cl. 688, 718 (2013).

130. *Id.* at 692, 717–18.

131. David D. Briske et al., *Catastrophic Thresholds: A Synthesis of Concepts, Perspectives, and Applications*, 15 No. 3 ECOLOGY & SOC'Y Art. 38, 1–3 (2010), *available at* http://www.ecologyandsociety.org/vol15/iss3/art38/.

persisted over time, eventually colliding to render the system of environmental and property rights governance in the Klamath Basin SES untenable. External shocks to the system, including the drought of 2000-2001 and the influence of federal-level officials and resources such as the 2002 NRC interim report, exacerbated the tension in social-ecological interactions between these factors.[132] Internal dynamics, such as lawsuits and entrenched battles over the best available scientific evidence on how to manage water and fish in the basin, created stagnation in environmental governance.[133] In addition, a feedback loop between management decisions and ecological conditions created low river flows in September 2002, precipitating the mortality event involving fall-run Chinook salmon and generally low numbers of salmon returning to the Klamath River between 2005 and 2008, which in turn triggered restrictions and closures in commercial salmon fishing harvests off the coast of Oregon, Washington, and parts of California.[134]

In essence, the ESA's legal mechanisms combined with a drought event, had illuminated the environmental, social, cultural, and economic costs of the old regime where subsidized agriculture was the dominant power, and instead redistributed power to fish and the human groups that aligned with them. The impact of these combined disturbances (ESA and drought) revealed that the resilience of nested systems within the Klamath Basin—in terms both of the ecological system's persistence as salmon and sucker habitat and the social system's persistence as a viable farming and ranching community—was significantly compromised and that both aspects of the Klamath Basin SES were quickly approaching a threshold that could lead to significant system transformation and potentially collapse. Somewhat ironically, however, although all interests in the Basin would likely have viewed the threat of an ESA-induced regime shift as undesirable, the status quo was equally undesirable. Operation of the ESA in the Klamath Basin was characterized by perpetual conflict between entrenched interests—a classic "rigidity trap"[135]—and seemed to offer no hope for forging a path forward toward an SES state that could accommodate the wide array of human desires for the river system; that is, the ESA challenged the prior *status quo* but offered little flexibility for moving forward.

The chaotic period of release also creates space for legacy contexts and other spatial and temporal cross-scale interactions to influence social-ecological dynamics.[136] In the Klamath Basin, for example, the 2001 water shutoff brought to light

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132. *See* DOREMUS & TARLOCK, *supra* note 27, at 4, 130–32 (discussing the involvement of Secretary of the Interior Gale Norton and the controversial release of the NRC interim report); BARTON GELLMAN, THE ANGLER: THE CHENEY VICE PRESIDENCY 195–214 (2008) (discussing the involvement of Vice President Dick Cheney); MOST, *supra* note 27, at 240, 283 (discussing the involvement of White House Senior Advisor and Deputy Chief of Staff Karl Rove). Doremus and Tarlock mention Norton's discovery of an "accounting error" in Upper Klamath Lake storage levels, allowing an additional 70,000 acre-feet of deliveries to flow from the Project in early summer. DOREMUS & TARLOCK, *supra* note 27, at 4. There is also significant speculation that Dick Cheney had acute interest in resolving the Klamath situation due to the nature of the political contests in the region and his desire to hold onto Republican congressional seats. GELLMAN, *supra* note 132, at 195–214. In his biography of Cheney, for example, Gellman suggests that Cheney "fast tracked" the Klamath NRC report and had influence over the release of a controversial preliminary report. *Id.*

133. DOREMUS & TARLOCK, *supra* note 27, at 112–44.

134. *See* DRAFT KLAMATH EIS/EIR, *supra* note 23, at 45–93.

135. GUNDERSON & HOLLING, *supra* note 5, at 95–98.

136. *Id.* at 75 (discussing the concept of "revolt").

extreme local mistrust of the federal government and racial intolerance, manifested in staged protests, illegal routing of water around closed headgates, acts of violence, and the indifference of local law enforcement officials to offenses supporting the *status quo*.[137]Reminiscent of the Sagebrush Rebellion and the Wise Use Movement in the western U.S., thousands of protesters descended upon the Klamath Basin in 2001 to offer support for Project irrigators in their plight against the federal government.[138]

During this release period, each party with a legal or cultural stake in the basin's water resources exploited its legal options to retain or gain priority in water deliveries as a hedge against uncertainty.[139] However, around 2004-2005, discussion amongst warring stakeholder groups began to take hold in a variety of venues in and outside the basin.[140]Although at first glance these ad hoc venues were hostile, unproductive, and seemingly exclusive, a purging of emotions took place during meetings, and side conversations or facilitated sessions began to set the stage (or "prepare the system") for what would become a "window of opportunity"—a moment in the adaptive cycle where humans can change the system's trajectory—for potential governance transformation in the Klamath Basin SES.[141]As a result of communicative dialogues amongst basin leaders,[142] a movement coalesced "away from litigation and towards dialogue, . . . with the presence and buy-in of federal officials," creating "space for a shift towards more collaborative governance."[143]

Gunderson and Holling employ the metaphor of a forest fire to describe the tenure of the release phase—the fire goes out when fuel is exhausted.[144]"So too did the height of crisis and conflict in the Klamath Basin fizzle and fade as parties exhausted litigation venues and grew weary of the constant name calling and accusations in the press. Forces that would shape a new direction in environmental governance stabilized—if only momentarily—long enough to see that an opportunity for a different trajectory was emerging. [While i]t wasn't immediately apparent that this new trajectory was better, it" *was* different, and it appeared to hold greater potential for the basin's future.[145]

137. *See, e.g.*, Jeff Barnard, *Farmers Stage Bucket Brigade to Protest Irrigation Shutoff*, CORVALLIS GAZETTE-TIMES (May 8, 2001, 12:00 AM), http://www.gazettetimes.com/farmers-stage-bucket-brigade-to-protest-irrigation-shutoff/article_bd67586d-67b2-5034-9c4e-31200be25031.html; *see also Protesters Occupy Irrigation Facility after Claiming Ownership*, DJC OR. (August 31, 2001, 1:00 AM), http://djcoregon.com/news/2001/08/31/protesters-occupy-irrigation-facility-after-claiming-ownership/; Jeff Barnard, *Three Admit Shooting Up Tribal Town during Water Dispute*, SPOKESMAN REV. (July 18, 2002), http://www.spokesmanreview.com/news-story.asp?date=071802&ID=s1184499.

138. Chaffin, *supra* note 8, at 1–2.

139. *See, e.g.*, Kandra v. United States, 145 F.Supp.2d 1192 (D. Or. 2001).

140. *See* Chaffin, *supra* note 8, at 102.

141. Per Olsson et al., *Shooting the Rapids: Navigating Transitions to Adaptive Governance of Social-Ecological Systems*, 11 No. 1 ECOLOGY & SOC'Y Art. 8, 2–4, 7–10 (2006), *available at* http://www.ecologyandsociety.org/vol11/iss1/art18/.

142. Messier, *supra* note 37, at 579–600.

143. Chaffin, *supra* note 8, at 104.

144. GUNDERSON & HOLLING, *supra* note 5, at 45.

145. Chaffin, *supra* note 8, at 104.

E. Reorganization Phase (α)

The transition from release to reorganization that took place in the Klamath Basin SES between 2005 and 2006 can only be described as messy, incremental, and uncertain. The original, eloquent description of this adaptive cycle phase shift by Gunderson and Holling succinctly characterizes what occurred in the Klamath during this period of transition:

> If the progress from r to K represents a prolonged period during which short-term predictability increases, the shift from Ω to α represents a sudden explosive increase in uncertainty. It is the phase where conditions might arise for formal chaotic behavior. This alteration between long periods of somewhat predictable behavior and short ones of chaotic behavior might result in systems periodically probing and testing limits. The process generates and maintains diversity—of, for example, species in ecosystems or functions in an organization. And that diversity "lies in waiting" to allow the system to respond adaptively to unexpected future external changes.[146]

The reorganization phase is marked by unpredictability: resources and capital are highly available and unconstrained by prior combinations or associations. The possibilities for recombination are endless and space for innovation opens.[147]

In the Klamath Basin, the "sea change of dialogue" that began with the ad hoc conversations began to progress towards exploring options for multiparty solutions.[148]With or without knowing it, Klamath Basin stakeholders were preparing the system for a transformation in environmental governance.[149]

The reorganization phase is not necessarily stable—as potential grows, so too does a system's resilience, but initially the system is weakly connected and vulnerable to external shocks. However, as noted, external influences can sometimes cultivate windows of opportunity for changing the interactions among system elements.[150]The Klamath Basin is in the midst of negotiating two such windows of opportunity—the potential removal of hydroelectric dams and the conclusion of Oregon's Klamath Basin water rights adjudication—that have already led to new agreements that could signify transformation and perhaps re-initiation of the adaptive cycle.

1.The FERC Relicensing Process and the Klamath Settlement Group

The first window of opportunity appeared during the early stages of reorganization in the Klamath Basin in the form of the expiration of PacifiCorp's FERC licenses to operate the Klamath Hydroelectric Project (KHP) and the subsequent alternative relicensing (settlement) process. The FERC licenses for the KHP expired in 2006, and because FERC is a federal agency, any renewal of the licenses would require a NEPA environmental assessment (and probably Environmental

146. GUNDERSON & HOLLING, *supra* note 5 at 45.
147. *Id.*
148. Chaffin, *supra* note 8, at 105.
149. Olsson et al., *supra* note 141, at 18.
150. *Id.*

Impact Statement),[151]Section 7 consultation under the ESA, and, most likely, modifications of the dams' operations to protect the SONCC coho.[152]

While concurrently challenging mandatory fish passage prescriptions that NMFS sought to impose, PacifiCorp initiated alternative settlement talks with basin stakeholders in 2005 under the assumption that the cost of constructing the prescribed mandatory fish passage would outweigh the cost of potential dam removal achieved through a negotiated settlement.[153]In 2006, after several unproductive meetings, a group of stakeholders broke off from talks with PacifiCorp in order to address the greater issues plaguing the basin, of which the KHP was a major part but not the focus. This extension of the FERC process—called the "Extended Caucus" and eventually the "Settlement Group"—met and negotiated extensively between 2006 and 2008.[154]A strict confidentiality agreement was signed by all participating parties[155]because of the sensitivity of the points negotiated—for example, a potential tribal water rights settlement in the Upper Basin and private dam and irrigation operation. In the end, not all parties decided to stay at the table,[156] but those who did reached a series of agreements representing reorganization—a plan for governance transformation that holds the potential to increase the resilience of the Klamath Basin SES.

2. The Klamath Basin Agreements

In February 2010, Klamath Basin stakeholders signed the Klamath Basin Restoration Agreement ("KBRA"), which provides for reduced withdrawals for irrigation and plans for comprehensive ecosystem restoration, among other things, and the companion Klamath Hydropower Settlement Agreement ("KHSA"), laying out a process for decommissioning and removing the four Klamath River dams.[157]The KBRA and KHSA were signed by participating non-federal stakeholders, introduced as congressional legislation in 2011, and amended/extended in December 2012.[158]Since that time, they have been challenged by and subjected to political forces at every level of U.S. government.[159]

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151. 42 U.S.C.A. § 4332(C) (West 2014).

152. ADLER ET AL., *supra* note 47, at 636.

153. DRAFT KLAMATH EIS/EIR, *supra* note 23, at ES-1 to ES-56.

154. Gosnell & Kelly, *supra* note 8, at 373.

155. [T]he group was led by a series of de facto and professional facilitators, some hired, some emerging as natural leaders from within the group. The Extended Caucus consisted of four tribes (Hoopa Valley, Karuk, Klamath, and Yurok), Project and Off-Project irrigators, environmental and conservation groups, California, Oregon, and direct representatives of the federal government (Department of Interior and Department of Justice and associated agencies such as USFWS, NMFS, BIA, etc.). Chaffin, *supra* note 8, at 107.

156. Not all demands of the parties were met in the KBRA process, evidenced by the departure of the environmental groups Oregon Wild and WaterWatch of Oregon in 2007, the North Coast Environmental Center (NEC) and Klamath Forest Alliance (KFA) in 2009, and the refusal of Hoopa Valley Tribe and Siskiyou County, CA to sign the final version of the Agreements. *Id.* at 108.

157. KBRA, *supra* note 20; KHSA, *supra* note 20; *see also* ADLER ET AL., *supra* note 47, at 636; Gosnell & Kelly, *supra* note 8, at 362.

158. KBRA, *supra* note 20; KHSA, *supra* note 20; *see also* U.S. DEP'T OF THE INTERIOR, FIRST AMENDMENT TO THE KLAMATH BASIN RESTORATION AGREEMENT FOR THE SUSTAINABILITY OF PUBLIC

In April 2013, the Secretary of the Interior found that removal of the four Klamath River dams is in the public interest.[160] However, "[t]he price-tag was steep—$800 million over 10 years—and Congress made no move to fund it."[161] As a result, the two Klamath agreements stalled, inspiring Oregon U.S. Senator Ron Wyden to create a task force to come up with a cheaper and more workable plan to implement the Klamath Basin agreements, which it delivered in October 2013.[162] However, at the time of this writing, Congress has not authorized federal agency participation in or funding for the Klamath Agreements.

3. Klamath Basin Adjudication and Tribal Water Rights

Throughout the last two decades of the 20th century, there was a growing awareness that Indian water rights could prove problematic for nontribal irrigators. Nevertheless, until a stream adjudication was completed or tribal water rights were otherwise quantified, it was possible to maintain a state of denial.

After more than three decades, as this article goes to press, Oregon's Klamath River adjudication is nearing completion. On March 7, 2013, the Oregon Water Resources Department ("OWRD") issued its Findings of Fact and Order of Determination.[163] Most importantly for the power dynamics of water governance in the Klamath Basin, the OWRD determined that the Klamath Tribes and their allottees have the most senior water rights in the system, with the Tribes' water rights dating to "time immemorial" and the allottees' rights having an 1864 priority date.[164]

As such, the Klamath Tribes are now the senior water rights holders in the system, with substantial water rights. As an illustration of what that means for the redistribution of power in the SES, when in 2013, the Klamath Basin again experienced severe drought, the Klamath Tribes relied on OWRD's order to "call" the river, demanding that the OWRD prevent use by more junior users—including the Bureau of Reclamation and Klamath Project—until the Tribes' water rights had been fulfilled. This call inspired new negotiations for the Upper Klamath Basin's water allocation.

AND TRUST RESOURCES AND AFFECTED COMMUNITIES (2012), *available at* http://216.119.96.156/Klamath/2012/Amendments.pdf (extending the agreement and modifying it).

159. *See* Chaffin, *supra* note 8, at 168–71.

160. Press Release, U.S. Dep't of Interior, Interior Dep't Releases Final Envtl. Analysis on Klamath River Dam Removal (April 4, 2013), *available at* http://www.doi.gov/news/pressreleases/interior-department-releases-final-environmental-analysis-on-klamath-river-dam-removal.cfm.

161. Peg Herring, *Klamath Basin Community Perseveres through Water Issues*, OR. STATE UNIV., http://oregonprogress.oregonstate.edu/winter-2014/kbrec/klamath-basin-community-perseveres-through-water-issues (last visited Jan. 9, 2015).

162. *Id.*

163. *Klamath River Basin Adjudication*, OREGON.GOV, http://www.oregon.gov/owrd/Pages/adj/index.aspx (last visited Jan. 8, 2015). These findings and recommendations are now subject to exceptions filed by the claimants; after the OWRD decides all the exceptions, it will issue a final decree. *See, e.g.*, Press Release, Or Water Res. Dep't, The Or. Water Res. Dep't Completes Klamath River Basin Adjudication (1975-2013) (Mar. 7, 2013) [hereinafter Department Completes Klamath Adjudication], *available at* http://www.oregon.gov/owrd/ADJ/docs/2013_03_07_Klamath_River_Basin_Adjudication_Media_Release_Final.pdf. (The OWRD reviewed 730 surface water rights claims over 38 years, including 5,660 contests to the claims.).

164. Department Completes Klamath Adjudication, *supra* note 163, at 2.

4. Upper Klamath Basin Comprehensive Agreement

The recognition and quantification of the Tribes' water rights again perturbed the Klamath Basin SES, further shifting the power dynamic surrounding water in the system. Indeed, because the Tribes' call on the river is based in water law and the prior appropriation doctrine, the OWRD's stream adjudication may have effectively shifted the Klamath Basin SES into a post-ESA reality in which the Tribes' water rights, and not the demands of the ESA,will drive water allocation. Regardless, the OWRD's 2013 order has already prompted new negotiations for water management in the Upper Basin.

Specifically, on March 4, 2014, the State of Oregon released its Proposed Upper Klamath Basin Comprehensive Agreement ("UKBCA").[165] The agreement pursues "four co-equal goals": to support the Klamath Tribes' economic development; to provide stable and sustainable agriculture in the Klamath Basin; to manage and restore riparian corridors in the Klamath Basin streams; and to resolve controversies over water rights resulting from the Klamath River Basin Adjudication.[166] The agreement would limit the continued exceptions and litigation over water rights in the Adjudication and would help to implement the water rights provisions of the Klamath Basin Restoration Agreement.[167] The Agreement would also create a comprehensive Water Use Program for the Klamath Basin that would increase flows into Upper Klamath Lake, limit calls on the system to designated conditions, and adjust the priorities of different kinds of water rights.[168] Obviously, many things could happen in the implementation of this Agreement, but it represents yet another effort to adjust the governance institutions for the Klamath Basin in ways that could increase the resilience of the entire SES.

IV. THE ADAPTIVE CYCLE AS A TOOL FOR IDENTIFYING THE FUTURE VULNERABILITIES OF THE KLAMATH BASIN SYSTEM AND DESIRABLE CHANGES IN SYSTEM GOVERNANCE

The narrative of exploitation, conservation, release, and reorganization provides a useful lens through which the trajectory of the basin SES can be understood, shedding light on the shifting resilience of environmental governance in the basin. The adaptive cycle heuristic also has some explanatory power in that it brings attention to cumulative forces of adaptation and transformation underlaying what appears to be simply a narrative of colonization, accumulation, and marginalization of people and resources.

We suggest that framing the history of the Klamath SES in terms of the adaptive cycle,also sets the stage for understanding the "next phase"—potential future

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165. KLAMATH TRIBES, PROPOSED UPPER KLAMATH BASIN COMPREHENSIVE AGREEMENT (2014), *available at* http://www.oregon.gov/gov/GNRO/docs/Proposed%20Upper%20Klamath%20Basin%20Comprehensive%20Agreement%20and%20Summary%20of%20Agreement/2014-3-4%20PROPOSED%20UPPER%20KLAMATH%20BASIN%20COMPREHENSIVE%20AGREEMENT.pdf.).

166. *Id.* at 5.

167. *Id.* at 5–9.

168. *Id.* at 12–32.

states, governance improvements, and reforms necessary to pursue what society decides is the most desirable of those states. Such insights can inform both future scenario planning and various foci for governance improvements.

A. The Klamath Basin SES's Potential Futures in a Climate Change Era

Three broad future trajectories for the Klamath Basin SES emerge out of our resilience assessment, each with a range of possible variations. First, the system could revert to overappropriation of water and a predictable collapse of both the aquatic ecosystems and the social communities that depend directly upon them. That is, using the "ball in a basin" metaphor, the system, currently perched on the "ridge" between two "basins," might roll back into the dysfunctional state that led to the 2001 conflagration. Second, the system could sustain its tenuous perch between basins, remaining in limbo for an indefinite period of time while various political interests fight for control of the system and unpredictable social and ecological shocks threaten to push the system one way or another. Finally, the system could move to a new basin of attraction characterized by a more adaptive governance system and begin to build resilience in both the aquatic ecosystems and the various human communities that depend on the basin's water and fish.

Complicating prediction of future trajectories, however, is the spectre of climate change and associated increases in frequency and intensity of drought. For example, the delicate balance of the second scenario would be increasingly difficult to maintain as increasing water shortages threaten to re-ignite the conflicts of 2001-2004. A recognition of climate change's increased stresses on the Klamath Basin, however, could strengthen the perceived need for and political will to both strengthen and implement measures to achieve the third scenario, perhaps overcoming some of the remaining governance impasses that we identify in Subpart B.

The rest of this subpart considers how climate change impacts might move the Klamath Basin SES toward and perhaps across particular social and/or ecological thresholds, potentially transforming the SES into an alternate state. These considerations are characterized using a multi-branched state-and-transition model that outlines the many future paths that the SES could take, with different resilience properties emerging as a result.

1. The Klamath Basin's Future Resilience in a Climate Change Era

Perturbations resulting from a changing climate, including the increased frequency and intensity of drought, loom large in the Klamath Basin's future. Climate projections predict an average temperature increase and precipitation decrease across the basin between 2035 and 2085, particularly during the months from June to August.[169] More alarming, however, is the prediction of a decrease in snowpack from 73% to 90% below current baseline.[170] This dynamic would certainly change the hydrology of the basin and many associated ecological processes currently de-

169. BRIAN R. BARR ET AL., PREPARING FOR CLIMATE CHANGE IN THE KLAMATH BASIN 1, 9 (2010) [hereinafter PREPARING FOR CLIMATE CHANGE], *available at* http://www.theresourceinnovationgroup.org/storage/KlamCFFRep_5-26-10finalLR.pdf.

170. *Id.*

pendent on the amount and timing of seasonal cycles of snowmelt. For example, significant changes in vegetation are predicted, including the "[p]artial to complete loss of maritime conifer" in the Lower Basin and the "replacement of sagebrush and juniper with grassland[s]" in the Upper Basin.[171]

Climate change impacts in the Klamath Basin are likely to be a significant factor in the fate of the basin's future resilience, and there are a myriad of potential outcomes related to interactions between a drying climate and the driving social and ecological variables in the basin. For example, in one potential future scenario, extended drought related to climate change could trigger an ecological threshold involving severe reductions in water quality and aquatic habitat (water levels and temperature) in Klamath Lake leading to the further collapse and extinction of the sucker population in the Upper Basin. This dynamic could in turn trigger social and legal feedbacks, such as decreased cooperation, increased litigation, and the potential crossing of an economic threshold related to the viability of the agricultural economy in both the project and off project lands, if irrigation water is curtailed because of tribal calls on water and an effort to protect endangered suckers.

Alternate regimes in the Upper Basin might include a complete dystopia, where climate change impacts combine with the ESA's and Tribes' legal ascendancy to render irrigated agriculture too unpredictable and risky to remain economically viable. Key stakeholders in the basin might revert to the litigious and non-cooperative social dynamics that were present in the basin leading up to and immediately after the 2001 release. The ESA might be implemented with less communication between agencies and different stakeholder groups, which would lead to greater uncertainty for Klamath Project irrigators, in turn potentially causing the loss of critical contracts with agri-businesses throughout the region and an eventual collapse of the agricultural economy. The Tribes may abandon their commitment to supporting the persistence of a productive agricultural economy and direct all of their water rights to in stream flow for fisheries at the expense of irrigated agriculture. As a result, the system might move across thresholds that reduce or eliminate the agricultural thread of the existing Klamath Basin SES, shifting the social resilience of the Klamath Basin even if the system's ecological resilience is maintained or slightly improved through greater tribal control over fisheries.

A future regime dominated by climate change, drought, and a rigid legal implementation of the ESA would likely trigger undesirable threshold dynamics in the Lower Basin as well. Ecologically, an increase in water temperature and a decrease in water quality would lead to more salmon die-offs, creating economic and social feedbacks for salmon fishing communities, both in tribal communities along the river and in commercial fishing communities along the coast. In this worst-case scenario, both geographical aspects of the SES (Upper and Lower Basin) would cross thresholds into undesirable future states: a depopulation of the basin, extinction of species, and a loss of livelihood and cultural identity for fishermen, irrigators, and tribes.

Conversely, ongoing water scarcity related to climate change might motivate stakeholders in the Klamath Basin SES to choose to fully implement, and even improve, the existing proposals—the KBRA, KHSA, and most recently, the

171. *Id.*

UKBCA—to create a more flexible, adaptable, and comprehensive water governance regime for the basin. Under this fully implemented new regime, fish, native ecosystems more generally, and downstream commercial fishermen would benefit from the removal of four Klamath River dams, enhanced fish passage, and increased water flows and lake levels throughout the system. Tribes would enjoy the benefits of their legally recognized water rights, which—as the 2013 call on the river amply demonstrated—ensures that their voice in the system is heard and generally inures to the benefit not only of the tribes but also the ecosystems and the downstream commercial fishermen. The Bureau of Reclamation and the irrigators would benefit from increased certainty and predictability regarding how the Klamath Basin Project would be managed from year to year, including increased predictability of when droughts and endangered species needs might require curtailment of water deliveries. Such predictability allows farmers and the Bureau to plan for low-flow years and even to begin to implement mitigation strategies for those years, such as the oft-proposed water bank.[172] While these governance improvements cannot guarantee—especially in the face of climate change—that the Klamath Basin will never cross thresholds into less desirable states, they would significantly improve the SES's resilience, giving the Klamath Basin a much better chance of maintaining the social and ecological components that define the current system.

2. State-and-Transition Modeling

As the discussion above reflects, our resilience assessment of the Klamath Basin in combination with climate change projections for the Basin resulted in the identification of a variety of scenarios for the Basin's future. The next question, of course, will be what kind of governance changes can help to avoid undesirable future states that the scenarios suggest and/or to promote the desirable ones. To address this question it is critical to identify potential system states, thresholds, and pathways likely to occur under current and potential environmental governance. To that end, we present here a state-and-transition model[173] of likely scenarios given potential interactions and feedbacks between legal, cultural, and ecologic system drivers [Figure 3].

Our state-and-transition model depicts a range of scenarios from the current degraded and fragmented ecological state of the basin towards either a more natural flow regime and regeneration of resources, or an increasingly engineered and potentially further degraded system. The benefit of this type of visual planning is twofold: (1) the identification of thresholds that governance actors agree *not* to cross and corresponding pathways that avoid specific threshold dynamics; and (2) framing potential transformations in governance in terms of building resilience to disturbance and achieving desired social-ecological regimes. The pathways identified in our state-and-transition diagram raise questions about the relative importance of legal structure versus social capacity in cultivating and supporting resilient, adap-

172. *I* U.S. GEOLOGICAL SURVEY, ASSESSMENT OF THE KLAMATH PROJECT PILOT WATER BANK: A REVIEW FROM A HYDROLOGIC PERSPECTIVE 9–12 (2005), *available at* http://www.klamathbasincrisis.org/pdf-files/Final_USGS_Assessment_of_Water_Bank0505.pdf.

173. RESILIENCE ALLIANCE, *supra* note 2, at 26–29.

tive governance systems. As the agreements sit in limbo waiting on federal authorization, the experiment continues to unfold.

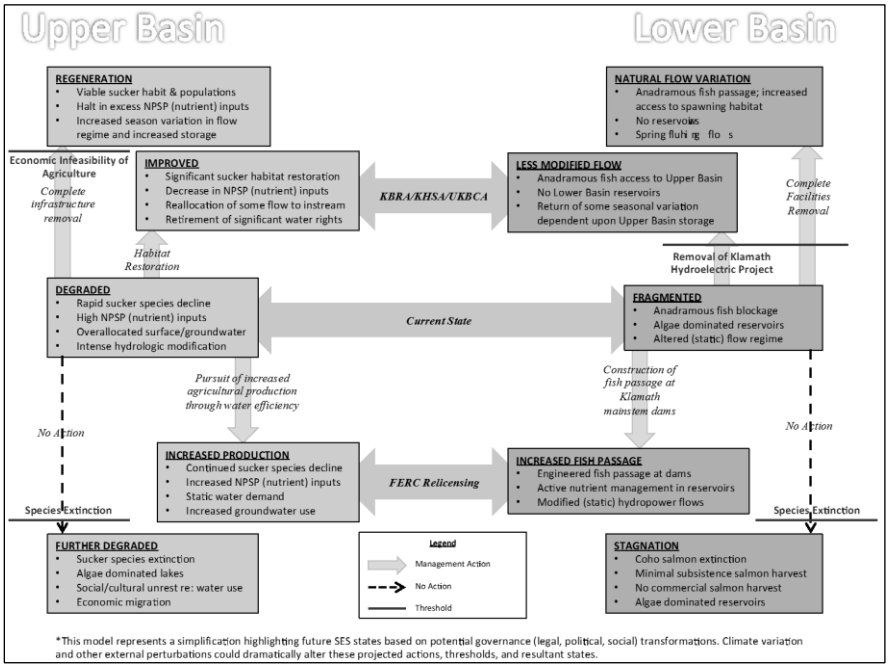

FIGURE 3: Conceptualization of the State-and-Transition Model of the Klamath Basin SES

B. Governance Choices for the Klamath Basin

A resilient, adaptable governance system in the Klamath Basin SES may be able to navigate an array of potential futures in the basin including strengthening the existing system or "gracefully" facilitating a transformation to a new regime—that is, with minimal controversy and displacement of existing interests. Indeed, one could argue that various combinations of these transitions are already in play and that the recent emergence of adaptive governance in the basin (in the form of increased cooperation and the three basin agreements) may be facilitating tolerable transitions even as drought remains a persistent stressor to water allocations.

Our resilience assessment of the Klamath Basin helps to identify key foci of such an improved and flexible governance regime. In particular, the late conservation and release phases in the Klamath Basin illuminated key impediments to increasing the basin's resilience to future perturbations: an infrastructure system of dams that limits the ability of key species to maintain healthy populations; overappropriation of both surface water and groundwater in the system, which both reduces flow rates and promotes water quality problems; entrenched conflicts among human water users exacerbated by a power structure that until recently, favored farmers and ranchers; and increasing droughts that underscore the vulnerability of the system. While little can be done about the last impediment, especially in light of climate change, modifications to dam infrastructure, human water use, and the

distribution of political and legal power are certainly feasible given appropriate governance changes.

To a large extent, the ESA and the Klamath Basin water rights adjudication have already done the important work of redistributing power in the Klamath Basin, at least for the moment. These two legal developments effectively have given the Klamath Tribes and the commercial fishermen an effective legal voice in the system, and the talks and negotiations initiated beginning in 2004 reflect a much altered power dynamic in the basin. The key for the future is to maintain this new balance of power and the increased collaboration and flexibility that has emerged with it.

The various Klamath Basin agreements, if implemented, would also improve governance related to dam infrastructure (by providing for dam removal and attendant ecosystem restoration) and water allocation and use. As such, with the full implementation of these agreements, the Klamath Basin SES is poised to enter a new governance regime that could promote enhanced resilience throughout the system.

It is somewhat ironic, therefore, that the same kinds of cross-scale interactions that provided the disturbances necessary to destabilize the prior dysfunctional governance regime are now providing lingering impediments to governance improvements. Specifically, a looming question remains related to the viability of the current governance system in the absence of formal recognition and funding by the federal government to make real all of the adaptation planning in the KBRA/KHSA/UKBCA. Can the proposed models on the table—which promote cooperation, experimentation, and flexibility in the face of disturbance—persist without formal institutionalization, given how much of their success is the result of enhanced (but hypothetically fleeting) social capacity?[174]

An alternative scenario to consider is that the proposed new comprehensive governance systems for the Klamath Basin are never fully realized but that the learned cooperation among the stakeholders, coupled with secure legal recognition and quantification of tribal water rights, could still stabilize the SES in a less formal but still vastly improved governance regime. Although new conditions have arisen[175] and the dam removal portions of the Klamath Agreements have yet to be authorized and funded by Congress, many of the key tenets of the Agreements that do not require federal authorization and funding are functionally in place or have caused informal but seemingly effective governance modifications in the basin.[176] Local governance regimes *are* in the process of changing, incrementally building resilience in the Klamath Basin SES.

Moreover, even though dam removal is still stalled at the time this article goes to press, national-level governance is changing in potentially relevant ways. For example, the USFWS and NMFS have modified their implementation of the

174. *See* Gosnell & Kelly, *supra* note 8, at 372–74.

175. *See generally* PREPARING FOR CLIMATE CHANGE, *supra* note 169 (discussing the many Klamath Basin issues).

176. *See* Chaffin, *supra* note 8, at 150–55; *see Klamath Basin Coordinating Council*, ED SHEETS CONSULTING, http://www.edsheets.com/Klamathdocs.html (last visited last visited Jan. 9, 2015) (providing the meeting documents), For example, the Klamath Basin Coordinating Council has met and produced yearly reports since February 2010.

ESA in the Klamath Basin in ways that appear to better promote both ecological *and* social resilience. The USFWS issued its most recent Biological Opinion for the Klamath Project on April 2, 2008, while NMFS issued its most recent Biological Opinion for the Project on March 15, 2010.[177] Jointly, both Biological Opinions are intended to govern the Klamath Project's operations until 2018.[178] Since their issuance, the Bureau of Reclamation has issued Annual Operations Plans for the Klamath Project. In the 2011 Annual Operations Plan, the Bureau relied on the Biological Opinions to develop and implement a "Variable Base Flow" procedure designed both to increase certainty and predictability for contract beneficiaries who depend on deliveries of water from the Project *and* to ensure that SONCC coho receive minimum required streamflows during critical periods.[179]

The Bureau issued its 2014 Operations Plan for the Klamath Project in April 2014.[180] In accordance with the Biological Opinions, the 2014 plan specifies that the Bureau must curtail deliveries of water when such "deliveries would cause the surface of [Upper Klamath Lake] to fall below the minimum elevation required"—namely, 4137.72 feet above sea level.[181]At that point, the Bureau anticipated shortages and curtailed deliveries during the 2014 irrigation season.[182] Nevertheless, and especially in conjunction with the negotiations that led to the two 2010 agreements, the Variable Base Flow procedure and relative paucity of ESA litigation in the Klamath Basin since 2007 suggest that this new governance mechanism both increases management flexibility in the Klamath Basin system and increases the resilience of this SES for both agriculture and fish; irrigators can better predict water deliveries in any given irrigation year, while the listed suckers and SONCC coho are guaranteed minimum lake levels and stream flows designed to ensure their survival.

V. CONCLUSION

In many ways, recent events in the Klamath Basin are a harbinger of what is to come in other parts of the arid and semiarid U.S. West as climate change results in more frequent droughts and as indigenous peoples gain more political power associated with their claims to water for reservation needs and environmental flows to protect culturally significant species. The potential for SES collapses in the face of persistent and severe perturbance is high, as the events of 2001-2002 in the Klamath Basin demonstrate, but so too is the potential for transformation to a new regime, as the untenability of current environmental governance becomes difficult to deny.

Considering the resilience of the Klamath River Basin SES is timely.While the social components of the Klamath Basin SES have moved into a reorganization

177. U.S. BUREAU OF RECLAMATION, KLAMATH PROJECT 2010 OPERATIONS PLAN 1 (2010), *available at* http://www.usbr.gov/mp/kbao/operations/2010/2010_OPS_PLAN.pdf.

178. *Id*.

179. U.S. BUREAU OF RECLAMATION, KLAMATH PROJECT 2011 OPERATIONS PLAN (REVISED) 1 (2011), *available at* http://www.usbr.gov/mp/kbao/operations/2011_OPS_PLAN.pdf.

180. U.S. BUREAU OF RECLAMATION, 2014 ANNUAL OPERATIONS PLAN, KLAMATH PROJECT (2014), *available at* https://www.usbr.gov/mp/kbao/docs/2014_Operations_Plan.pdf.

181. *Id.* at 2.

182. *Id.* at 2–3.

phase, it is unclear whether the ecological system is recovering or will continue to collapse. Ongoing holistic assessment of social-ecological resilience in the Klamath system—drawing on consistent inclusion of ecological and climate prediction data—will continue to reveal critical feedbacks between social and ecological components of the system as well as system drivers and information critical for identifying potential disturbances, thresholds, and regime shifts. Given the current transition phase of environmental governance in the Basin, this information may be utilized to facilitate a targeted regime shift towards one of the more desirable future states for the SES by focusing governance changes and improvements on key impediments and opportunities.

Our resilience assessment suggests that Klamath Basin inhabitants have already made considerable progress toward a new and more flexible governance regime that could help them to avoid systemic collapse and increase the resilience of desirable functions both to legacy damage and to future climate change. The Klamath Basin could, however, transform its governance regime even further towards increased resilience given more formal institutionalization of recent innovations—although that future is far from certain. In 2006, legal scholars Holly Doremus and Dan Tarlock offered an exceptional exposé and review of legal proceeding and battles over science in the Klamath Basin between roughly 2001-2006, ending with a tone of cautious optimism.[183] With the advantage of several more years to observe the Klamath Basin SES and its governance systems, we offer a similar, yet perhaps more optimistic assessment of the Klamath Basin SES and its resilience going into the future.

183. DOREMUS & TARLOCK, *supra* note 11, at 206–08.