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Chile, the Biobio, and the Future of the Columbia River Basin

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JERROLD A. LONG,* SHANA HIRSCH,** JASON WALTERS***

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I. INTRODUCTION

Over the last two years, three different groups of students and faculty from the University of Idaho's Water Resources program have visited Concepción, Chile to study water resource issues in the Biobío River Basin. As part of a National Science Foundation funded Integrated Graduate Education and Research Traineeship (IGERT) program,[1] these visits sought to expose the Idaho students to water resource issues in a different legal, cultural, and physical environment. Hosted by the European Union-Latin American (EULA) Center for the Environment/Faculty of Environmental Sciences located at the University of Concepción and the Civil Engineering Department at the Catholic University of the Most Holy Conception, the program also gave the students the opportunity to collaborate with Chilean researchers and students. While the students (and their faculty advisors) succeeded in learning a significant amount of information in a short period of time—with invaluable help from Chilean students and faculty colleagues—the most significant lessons learned in Chile were not about the Biobío or Chilean law or culture. Rather, the most significant, and hopefully longest-lasting, lessons were about the water resource issues we face at home in Idaho.

One of our challenges was to avoid viewing Chile only through the lens of our own experiences. When comparing our legal institutions—in this case, water resource institutions—to those of developing nations, it is simplest to assume that our successes are the result of wise choices, careful and strategic institutional design, a free-market economy, or legal stability. Our first response to a problem is often, "well, this is what we do…," with the implicit assumption that our approach should work in the new context as well. And to some extent, it was an appreciation of a U.S.-style market economy that led Chile's "Chicago Boys" to develop a water code that relies almost entirely on privatization and freely tradable

1. *See Integrative Graduate Education & Research Traineeship*, U. OF IDAHO http://www.uidaho.edu/cals/departments/water-resources/igert (last visited Oct. 19, 2016); *IGERT: Adaptation to Change in Water Resources: Science to Inform Decision-making Across Disciplines, Cultures and Scales*, NAT'L SCI. F. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1249400 (last visited Oct. 19, 2016).

water rights, with little to no government regulation over how, where, when, why, or even if water is used.[2]

But what appear to be benefits of our system, relative to Chile—i.e., situations in which we seem to avoid conflict—might rather be byproducts of our own mistakes, or the luck of historical, geographical, or ecological context. Thus, we should be cautious when we assess water resource conflicts in new geographical, ecological, hydrological, legal, and cultural settings. It may be, and perhaps is likely, that what has worked for us will not work in a different context. Perhaps less obvious, but more important, is that climate change will ultimately render a new Columbia River Basin that is different ecologically, hydrologically, culturally, and perhaps legally from what we know today—our own home will transition to that different context for which our current institutions might not work.[3]

This article will use the Chilean water resources experience—with a particular focus on dams and water infrastructure development in the Biobío River Basin—as a context for considering how climate change might affect water resources and water resource management in the Columbia River Basin. Because Chile might provide a useful example for how climate change might affect the Columbia River Basin, the first section will discuss the similarities and differences between the two places and how climate change likely will affect them both. The second section will provide brief development histories, focusing on dam and other infrastructure

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2. There have been gradual, incremental changes in Chile's Water Code since it was first enacted in 1981. But these have been both minor and limited to rights obtained in the future. Given that the Chilean system incentivized and protects speculation, these non-retroactive reforms are of limited effect. *See* Silvia Borzutzky & Elisabeth F. Madden, *Markets Awash: The Privatization of Chilean Water Markets*, 25 J. INT'L DEV. 251 (2013) [hereinafter Borzutzky & Madden].

3. Many studies over the past couple of decades demonstrate the potential effects of climate change on the Columbia River Basin. Generally speaking, in addition to higher temperatures, we should expect to see more precipitation fall as rain, reduced winter snowpack, earlier spring runoff, and lower summer stream flows. The associated social and cultural effects are more difficult to predict. *See* Alan F. Hamlet & Dennis P. Lettenmaier, *Effects of Climate Change on Hydrology and Water Resources in the Columbia River Basin*, 35 J. AMER. WATER RESOURCES ASS'N 1597 (1999); Jason C. Leppi et al., *Impacts of Climate Change on August Stream Discharge in the Central-Rocky Mountains*, 112 CLIMATIC CHANGE 997 (2012); Huan Wu et al., *Projected Climate Change Impacts on the Hydrology and Temperature of Pacific Northwest Rivers*, 48 WATER RESOURCES RES. W11530 (2012); Julie A. Vano et al., *Seasonal Hydrologic Responses to Climate Change in the Pacific Northwest*, 51 WATER RESOURCE RES. 1959 (2015).

development in the two countries. The third section will address differences in legal regimes, and the fourth section will address the different environmental contexts and effects. Finally, this article will conclude with an assessment of what the Chilean experience suggests about the future of water resources in the Columbia River Basin.

II. FINDING LESSONS IN THE DIFFERENCES: WHY COMPARING CHILE AND THE COLUMBIA RIVER BASIN MAKES SENSE

Initially, it might seem that Chile and the Columbia River Basin are too different for any comparison or contrast to offer useful lessons. But it is this fact that makes a comparison so interesting and potentially useful. Because the two places do share one important similarity: both Chile and the Columbia River Basin likely will experience significant changes in their water regimes and their capacity to adapt to these changes over the next decades due to climate change. It is precisely those changes that make the comparison most useful. A climate change altered Columbia River Basin will not be the same place in which our water resources history and infrastructure developed. It will be different ecologically, hydraulically, and maybe eventually, culturally and legally. Looking at how other places have developed and adapted to different conditions therefore becomes an important way to imagine different climate and governance futures.

A. Climate Change and Altered Hydrologic Regimes

Researchers at the Climate Impacts Group at the University of Washington have demonstrated that changes in both precipitation and temperature have already affected the hydrologic regime of the Columbia River Basin.[4] These changes are expected to continue, with most watersheds experiencing a shift from high-elevation precipitation in the form of snow to rain.[5] These climatic

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4. JOHN T. ABATZOGLOU ET AL., CLIMATE CHANGE IN THE NORTHWEST IMPLICATIONS FOR OUR LANDSCAPES, WATERS, AND COMMUNITIES 48 (Meghan M. Dalton, Philip W. Mote & Amy K. Snover, eds., Island Press 2013). For more on work done by the Climate Impacts Group, see *Climate Impacts Group*, UNIV. OF WASH. https://cig.uw.edu/ (last visited Oct. 19, 2016).

5. The temperature is expected to rise by 2.0°F to 8.5°F from the period from 1970-1999 to 2041-2070 depending on the model, and annual average precipitation is projected to

changes will effectively shift the spring peak flows earlier in the season, and decrease late-summer flows.[6] The warmer summers are, in turn, expected to lengthen the growing season, leading to increased water demand from irrigators.[7] Hydropower will also be affected by the new climate regime, with summer production expected to decrease by around 15% by 2040, and winter production seeing a slight increase of around 5%, not including adjustments that will need to be made in flow releases for endangered anadromous fish.[8]

Similarly, climate models for Chile suggest significant changes in the future. Those models have consistently projected a warming and drying trend that will continue through the 21st century,[9] with severe impacts to agriculture and hydropower.[10] The Andes have already experienced an increase of 1 to 1.5 °C since 1900, which is approximately three times the rise in the global-average temperature.[11] The Intergovernmental Panel on Climate Change has also indicated that the precipitation in the Biobío Region is likely to decrease by 15 to 20 percent by late this century.[12] Furthermore, the Zero Celsius Degree Isotherm (ZDI), which demarcates the elevation at which precipitation transitions from rain to snow, has increased by an average of twenty-three meters per decade since 1958.[13] The combination of higher temperatures and

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change by -5% to +14% for 2014-2070 with summer rainfall decreasing by up to 34%. *Abatzoglou*, at 33.

6. *Id.*

7. *Id.* at 47.

8. *Id.* at xxiv-xxv.

9. *See* Margot Hill Clarvis & Andrew Allan, *Adaptive capacity in a Chilean context: A Questionable Model for Latin America*, 43 ENVTL. SCI. AND POL'Y 78, 82 (2013).

10. *See* Bauer, *infra* note 12, at 645.

11. *See* Margot Hill, *Climate Change and Water Governance: Adaptive Capacity in Chile and Switzerland*, *in* 54 ADVANCES IN GLOBAL RESEARCH 120 (Martin Beniston, et al., eds. Springer Netherlands 2012).

12. *See* Carl J. Bauer, *Dams and Markets: Rivers and Electric Power in Chile*, 49 NAT. RESOURCES J. 583, 645 (2009).

13. *See* Rodrigo Valdés-Pineda et al., *Water governance in Chile: Availability, Management, and Climate Change*, 519 J. OF HYDROLOGY 2538, 2559 (2014).

decreased precipitation will affect both the volume of glaciers and snowpack in the Andes, as well as the seasonality of runoff from their melting, reducing their ability to serve as "reservoirs" for downstream dry-season water use.[14] Studies have already demonstrated glacier shrinkage in Central Chile.[15] Chile is also disproportionately affected by natural climatological phenomena such as the Pacific Decadal Oscillation (inter-decadal variability) and El Niño/La Niña (inter-annual variability), which affect both precipitation and temperature and further complicate climate forecasting.[16] A 2009 United Nations Study concluded that the reduction in precipitation alone could result in a loss of US$100 million per year for hydropower generation.[17]

Given the potentially significant changes that climate change might cause in ecological, hydrological, and all environmental systems across the globe, and particularly in snow dominated systems, the futures of both the Columbia River Basin and Chile might be radically different than conditions are today. We therefore must be extremely cautious as we think about how what we do today might or might not work tomorrow in this "new normal" of an altered climate. That is precisely the reason we should look for examples of how we might be able to adapt in a climate-altered future. In Chile, current conditions—which include relatively less winter snow and more winter rain—are a potential analogy for a climate altered Columbia River Basin. How Chile adjusts, if it does, to climate change thus might provide some useful foreshadowing.

B. United States Analogues to the Biobío

Even if Chile's more rain-dominated precipitation regime is similar to what we will experience in a climate-altered Columbia River Basin, other non-precipitation elements seem rather different. So given the obvious cultural, social, legal, and geographical differences between Chile and the Columbia River Basin, what might Chilean river systems like the Biobío have to say about water resources in the Columbia River Basin? From a cultural and

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14. *See* Clarvis & Allen, *supra* note 9, at 82.

15. *See* Valdés-Pineda, *supra* note 13, at 2559.

16. *See* Hill, *supra* note 11, at 164.

17. *See* Bauer, *supra* note 12, at 645.

economic perspective, the Biobío River is Chile's most important river system, and thus plays a cultural and economic role similar to the Columbia River. The Biobío is Chile's second largest and most developed river, flowing through the country's second largest metropolitan area.[18] It produces almost 50% of Chile's hydroelectricity, and nearly 20% of its total electricity.[19]

Beyond that very general comparison, finding a U.S. analogue for the Biobío is difficult but useful, because the Biobío teaches more with its differences than with any apparent similarities. Chile is famously narrow, averaging approximately 110 miles in width from the peaks of the Andes to the Pacific Ocean, while running over 2,600 miles north to south—California, in comparison, is over twice as wide at 350 miles, but only 770 miles long north to south.[20] As a result, Chilean rivers are short and steep, dropping quickly from the mountains to the central valley and the ocean. Of rivers in the western U.S., the Sacramento River is the most similar, descending rapidly from the Sierra Nevada into the Sacramento Valley. However, the Sacramento Basin is almost three times the size of the Biobío Basin, and the Sacramento River itself is 70% longer.[21] Even with its much larger watershed, the Sacramento's average annual flow is only two-thirds that of the Biobío.[22]

Similarly, compared to Idaho river basins, the Biobío produces a very large amount of water in a relatively small area. The mean

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18. Daniel Harris-Pascal, *Fluvial Geomorphology of the Bió-Bió basin: Catchment Processes and Possible Rehabilitation of Chile's Second Largest River System*, ACADEMIA.EDU (Feb. 2014), http://www.academia.edu/11802085/Geomorphology_and_microcatchment_management_of_the_Bio-Bio_Basin_Chile.

19. Chile has several power distribution systems. By far the largest is the Sistema Interconectado Central (SIC), which provides power for over 90% of Chile's citizens. The SIC's installed capacity, including the capacity of each individual power facility, is available here: Comision Nacional de Energia, *Electridad*, CNE.CL, http://www.cne.cl/estadisticas/energia/electricidad (last visited Oct. 5, 2016).

20. *Chile,* ENCYCLOPEDIA BRITANNICA, https://www.britannica.com/place/Chile (last visited Oct. 5, 2016); *California*, WORLD ATLAS, http://www.worldatlas.com/webimage/countrys/namerica/usstates/calandst.htm (last visited Oct. 5, 2016).

21. See Theodore E. Grantham et al., *Water management in Mediterranean river basins: a comparison of management frameworks, physical impacts, and ecological responses*, 719 HYDROBIOLOGIA 451, 455 (2012).

22. *See id.*

annual flow at the Biobío's mouth is about the same as the Snake River above Lewiston (about 34,000 cfs).[23] But the total size of the Biobío basin is just 10% of the Snake River Basin upstream of Lewiston.[24] That portion of the Upper Snake River Basin above Howell's Ferry near Minidoka drains 15,700 square miles,[25] still almost 70% larger than the total Biobío Basin. Yet, the Snake River's average annual flow at Howell's Ferry is just 6,500 cfs, or less than 20% of the Biobío's annual average flow.[26] Put another way, the Biobío Basin produces almost ten times more water per unit area than the Snake River Basin.

Although the Snake and the Biobío seem to share little in common, the Snake River Basin's reservoir storage capacity above Howell's Ferry is approximately the same as the Chilean government's original goal for reservoir storage of the mainstem Biobío River—about 4 million acre-feet—and thus the Snake makes for an interesting comparison.[27] The Biobío River's three large mainstem dams currently have a maximum storage capacity of about 1.2 million acre-feet of water,[28] the same as a single reservoir in the Upper Snake: Palisades Reservoir, the second largest reservoir in

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23. Harris-Pascal, *supra* note 18; Stream flow data for the USGS gauge near Anatone, Washington (upstream from Lewiston) dating back to July 1958 is available at: U.S. Geological Survey, *USGS Current Conditions for Idaho*, USGS.GOV, http://waterdata.usgs.gov/id/nwis/uv/?site_no=13334300 (last visited Oct. 5, 2016).

24. *See* Harris-Pascal*, supra* note 18*;* Stream flow data at Howell's Ferry near Minidoka dates to April 1910, U.S. Geological Survey, *NWIS Site Information for USA: Site Inventory,* USGS.GOV, http://waterdata.usgs.gov/nwis/inventory/?site_no=13081500 (last visited Oct. 5, 2016) [hereinafter *NWIS Site Information*].

25. *NWIS Site Information*, *supra* note 24.

26. U.S. Geological Survey, *Water-Year Summary for Site USGS 13081500*, *USGS.GOV,* http://waterdata.usgs.gov/nwis/wys_rpt?dv_ts_ids=45445&wys_water_yr=2015&site_no=13081500&agency_cd=USGS&adr_water_years=2006%2C2007%2C2008%2C2009%2C2010%2C2011%2C2012%2C2013%2C2014%2C2015&referred_module= *(*last visited Oct. 5, 2016) [hereinafter *Water-Year Summary*]; Harris-Pascal, *supra* note 18.

27. *See* John Sears & Katherine Bragg, *Bio-Bio: A River Under Threat*, The Ecologist, 1987, at 15, 16.

28. *See Chile Hydroelectricitas*, ENDESA.CL http://www.endesa.cl/es/conocenos/nuestronegocio/centrales/Paginas/chilehidro.aspx (last visited Oct. 5, 2016).

that part of the Snake River basin.[29] Rivers in the western United States are far more developed, and have far greater reservoir storage capacity, than the Biobío, even if their total flows are much less. One reason for this is the limited amount of space that exists between the Andes and the Pacific Ocean—there simply is not as much room for dams and reservoirs. However, the few dams in the Biobío River are fairly new and further dam development could result in the river more closely resembling the overall artificially constructed nature of the Snake River.

III. WATER RESOURCE HISTORIES

Although it has a relatively shorter experience with European settlement and irrigated agriculture—Idaho's capital city was incorporated in 1863,[30] more than four centuries after Santiago, Chile was founded in 1541[31]—the Columbia River Basin has had more substantial experience with large-scale and environmentally-significant water infrastructure and development. The different historical and political experiences of the two places could have significant effects on their futures.

A. "Redemption" of the arid lands—Water resource development in the Columbia River Basin

The Columbia River Basin was developed in a historic moment that differs greatly from today's Biobío Basin in Chile. The New Deal and the Federal planning and development of both the hydropower and irrigation projects on the Columbia and Snake Rivers took place during an "era of profound technological optimism in humankind's ability to control nature."[32] This paradigm resulted in the transformation of the natural and ecological processes in the

29. U.S. DEP'T OF THE INTERIOR BUREAU OF RECLAMATION, *Major Storage Reservoirs in the Upper Snake River Basin*, USBR.GOV, http://www.usbr.gov/pn/hydromet/burtea.html (last visited Oct. 5, 2016).

30. *Idaho Territorial Sesquicentennial*, ELMORECOUNTYPRESS.COM, http://www.elmorecountypress.com/Hi-Liting%20Idaho.htm (last visited Oct. 5, 2016).

31. *Santiago, Chile,* ENCYCLOPEDIA BRITANNICA, https://www.britannica.com/place/Santiago-Chile (last visited Oct. 5, 2016).

32. Paul W. Hirt & Adam M. Sowards, *The Past and Future of the Columbia River*, *in* THE COLUMBIA RIVER TREATY REVISITED: TRANSBOUNDARY GOVERNANCE IN THE FACE OF UNCERTAINTY 116 (Barbara Cosens ed., Or. State Univ. Press 2012).

Columbia Basin: the industrialization that its power fueled, and the use of irrigation to turn desert into farmland—the creation of what historian Richard White has called an "organic machine."[33] Whether this has been a "success," and for whom, is a topic for another time, but there is no doubt that nature was transformed on a massive scale. In turn, this political culture and management paradigm influenced the legal regime that developed—both the transboundary Columbia River Treaty (1964) with Canada and state and Federal water law prioritize particular uses and interests in specific locations.[34] This includes prioritization of irrigation rights in the upriver, Snake River Basin and Columbia Basin Projects, while at the same time constructing large-scale hydropower dams that would not interfere with irrigation, but could even facilitate and prioritize it.

The Columbia River Basin was thus the site of a utopian project with a strong Federal government role in regional planning, and a vision of social progress that rested on putting the river to work.[35] The Newlands Reclamation Act of 1902 created the Bureau of Reclamation and initiated a massive federal effort to irrigate the arid West.[36] The Federal Water Power Act in 1920 created the Federal Power Commission (now the Federal Energy Regulatory Commission) to license and coordinate the creation of hydroelectric facilities.[37] In addition to these agencies, the U.S. Army Corps of Engineers was created in 1802 as a separate branch in the Army.[38] It largely took over the nation's flood control responsibilities during

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33. RICHARD WHITE, THE ORGANIC MACHINE: THE REMAKING OF THE COLUMBIA RIVER (Hill and Wang 1996).

34. Columbia River Treaty, Can.-U.S., Jan. 17, 1961, 15 U.S.T. 1555.

35. DONALD WORSTER, RIVERS OF EMPIRE: WATER, ARIDITY, AND THE GROWTH OF THE AMERICAN WEST 271–72 (Am. Environmentalism ed., Oxford Univ. Press 1985).

36. U.S. Dept. of Interior Bureau of Reclamation, *The Bureau of Reclamation: A Very Brief History*, USBR.GOV, (Jan. 12, 2016), http://www.usbr.gov/history/borhist.html.

37. 16 U.S.C. §§ 792, 803 (2012).

38. U.S. Army Corps of Engineers, *A Brief History: Introduction*, USACE.ARMY.MIL, http://www.usace.army.mil/About/History/Brief-History-of-the-Corps/Introduction/ (Last visited Oct. 5, 2016).

the early 20th Century, incorporating hydropower facilities wherever possible,[39] as should be unsurprising given their specific missions, these agencies were in the business of dam-building. The New Deal policies of Franklin D. Roosevelt fueled development in the Columbia River Basin, through large-scale planning and development that lasted until the 1960s.[40] Until the Hells Canyon dam complex controversy in the late 1950s, almost all of these projects were public projects, perceived to generate economic benefit to the greatest number of people in the Pacific Northwest.[41] These Federal projects, in addition to the doctrine of prior appropriation in western water law, provided political, legal, and financial power for irrigators that lasts to this day.

To say that the consequences of the dam-building era in the Columbia River Basin have been significant is to grossly understate the effects. There are now sixty dams in the Columbia River Basin, ranging in size from the massive Grand Coulee dam on the Columbia to the dozens of small irrigation dams and diversions scattered across the basin.[42] It is estimated that 55% of historic salmon and steelhead spawning habitat has been blocked due to dams and other obstructions.[43] As alluded to in the previous section, compared to the Biobío basin, for example, the Columbia River Basin is already largely developed, from a dam building perspective. As incidents like the 1975 Teton Dam collapse suggest, even if dam building were culturally, politically, or economically

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39. *See* U.S. Army Corps of Engineers, *A Brief History: Responding to Natural Disasters*, USACE.ARMY.MIL, http://www.usace.army.mil/About/History/Brief-History-of-the-Corps/Responding-to-Natural-Disasters/ (Last visited Oct. 5, 2016).

40. U.S. Army Corps of Engineers, *A Brief History: Multipurpose Waterway Development*, USACE.ARMY.MIL, http://www.usace.army.mil/About/History/Brief-History-of-the-Corps/Multipurpose-Waterway-Development/ (Last visited Oct. 5, 2016).

41. KARL BOYD BROOKS, PUBLIC POWER, PRIVATE DAMS: THE HELLS CANYON HIGH DAM CONTROVERSY (William Cronon ed., 2009).

42. *See* U.S. Army Corps of Engineers, *Water Management For The Pacific Northwest Reservoir System*, http://www.nwd-wc.usace.army.mil/pdf/wmbroch.pdf (last visited Oct. 5, 2016).

43. Compilation of Information on Salmon and Steelhead Total Run Size, *Catch and Hydropower Related Losses in the Upper Columbia River Basin, Above Grand Coulee Dam,* 111, https://www.nwcouncil.org/reports/1985/ucut-fisheries-technical-report/ (last visited Sept. 14, 2016).

acceptable in the early 21st Century Columbia River Basin, only marginal dam sites remain. In fact, as the Elwha and Klamath Rivers demonstrate—as well as, to a lesser extent, the simmering controversy over the four Lower Snake River dams—the Columbia River Basin might now be on a return trajectory from the peak of its dam-building era.

That said, dams and the impacts of the dam-building era are still an integral element of the Basin's legal, cultural, and physical landscapes. Legal scholar Charles F. Wilkinson has described the legacy of 19th- and early-20th-century natural resource laws as the "lords of yesterday."[44] In the western U.S., these pervasive, and in many instances "outmoded" laws, policies, and ideas, continue to powerfully influence, enable, and constrain us.[45] These are laws that, according to Wilkinson, "arose under wholly different social and economic conditions but that remain in effect due to inertia, powerful lobbying forces, and lack of public awareness."[46] A closer examination of the legal system demonstrates how this led to the differences in development trajectory between the Columbia and Snake River Basins in the United States, as well as the Biobío Basin in Chile. How these "lords of yesterday" will facilitate or prevent adaptation to climate change also touches a deeper point about how law itself can facilitate adaptation or resilience.[47]

B. Dams and the Engines of Economic Development in Chile

Whereas much of the development in the western US began during the New Deal era, a significant amount of economic development in Chile occurred under the Pinochet and Concertación governments between 1973 and 2010.[48] This rapid growth led to

44. CHARLES F. WILKINSON, CROSSING THE NEXT MERIDIAN: LAND, WATER, AND THE FUTURE OF THE WEST 17 (1992).

45. *Id.* at xiii.

46. *Id.* at 17.

47. Barbara Cosens, et al., *The Adaptive Water Governance Project: Assessing Law, Resilience and Governance in Regional Socio-Ecological Water Systems Facing a Changing Climate: Introduction to NREL Edition of the Idaho Law Review*, 51 IDAHO L. REV. 1, 27 (2014).

48. Rapid economic development during this period is demonstrated by the 6.2% real yearly growth in gross domestic product (GDP) between 1980 and 2010. *See* Valdés-Pineda, *supra* note 13, at 2544. "In 1990, Chile finally returned to an elected democratic government. Since then, the country has been governed by a coalition of center-left political parties known as the *Concertación*, whose members were political opponents of the military regime. Despite

Chile becoming the first country in South America, and only the second country in Latin America, to join the Organization for Economic Co-operation and Development (OECD) in 2010.[49] The OECD is considered to be an "elite grouping of 'democratic' and 'developed' states".[50]

However, unlike the U.S. approach to infrastructure development, with the direct and significant involvement of the central government, Chile has relied on laws and subsidies that promoted private sector development and free market principles. Unlike other Andean states, Chile is considered to have "strong institutions, low corruption, and stable politics," thus supporting the levels of private investment required to support large infrastructure projects.[51] Chile's success with this approach has resulted in a comparatively large middle class and "relatively high levels of wealth and urbanization" as compared to its Andean counterparts.[52]

But despite its appearances of stability on the surface, Chile has an economic vulnerability in the fact that its economy is almost entirely based on natural resource exports.[53] Furthermore, approximately three-fourths of Chile's economic productivity is water intensive.[54] As such, the rapid economic and social growth of the past

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these dramatic political advances, however, the four successive governments of the *Concertación* have had to maintain core elements of the institutional legacy of military rule—in particular the 1980 Constitution and the neoliberal economic model." *See* Bauer, *supra* note 12, at 595. The Chilean Concertación (the Concert of Parties for Democracy) held power from the end of the Pinochet regime in 1990 until Piñera's victory over Eduardo Frei in 2010. *See* Kevin Funk, *"Today There Are No Indigenous People" in Chile?: Connecting the Mapuche Struggle to Anti-Neoliberal Mobilizations in South America.* 4 J. OF POL. IN LATIN AMERICA 125, 134 n. 8 (2012).

49. Org. for Econ. Co-operation and Dev., *Members and partners*, OECD.ORG http://www.oecd.org/about/membersandpartners/ (last visited Oct. 5, 2016).

50. *See* Funk, *supra* note 48, at 126.

51. *See* Javiera Barandiaran, *Chile's Environmental Assessments: Contested Knowledge in an Emerging Democracy*, 24 SCIENCE AS CULTURE 5 (2015).

52. It is important to note that despite the level of development, Chile continues to maintain an extremely high level of income inequality, more than any other OECD country. *See* Funk, *supra* note 48, at 129.

53. *See* HILL, *supra* note 11, at 165.

54. *Id.*

decades has resulted in increasing demands for surface and ground water to the point that water resources in the northern half of Chile are almost fully allocated to economic activities.[55] In 2006, for example, water use reached 4,710 cubic meters per second, 89% of which corresponded to non-consumptive uses (primarily irrigation).[56] The Chilean government currently has plans to increase the country's irrigated area by 57% by 2022, reaching 1.7 million hectares.[57]

In the Biobío Region, development has been based around agriculture, forestry, fishing, and previously, coal mining.[58] Approximately 705 square kilometers of the Biobío River Basin is used for irrigated agriculture, which accounts for about 70% of the net total water withdrawals in the basin.[59] Primarily an industrial agriculture zone, the basin is dominated by dairy farms, sugar beets, and maize and other feed crops for dairy cattle.[60] The forestry sector accounts for over 4,600 square kilometers of the Biobío Basin.[61] Regional forestry production volume increased by 1.3 million m^3 between 2004 and 2010, and now accounts for 57% of the national forestry production and 77% of all regional exports.[62] Not only is it important to consider the effects of these artificial forests on the hydrological cycle, but forest plantations have also displaced irrigated agriculture in some areas of the Basin[63] and are taking advantage of better soil quality and moisture content.

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55. *See* Valdés-Pineda, *supra* note 13, at 2544.

56. *Id.* at 2546.

57. *Id.*

58. *See* Robinson Torres et al., *Vulnerability and Resistance to Neoliberal Environmental Changes: An Assessment of Agriculture and Forestry in the Biobío Region of Chile (1974–2014)*, 60 GEOFORUM 107, 111 (2015).

59. *See* Grantham, *supra* note 21, at 455, 458.

60. *See* Torres, *supra* note 58, at 112–113.

61. *See* Grantham, *supra* note 21, at 455.

62. *See* Gonzalo Falabella & Francisco Gatica, *Sector forestal-celulosa, agricultura de secano e industria en el Gran Concepción:¿ encadenamiento productivo o enclave?*, REVISTA CEPAL 197, 200 (Apr. 2014) http://www.cepal.org/publicaciones/xml/6/52486/RVE112FalabellaGatica.pdf.

63. *See* Torres, *supra* note 58, at 116.

The rise in social and economic development in Chile also resulted in greater demands for energy. Chile's federal Electric Law requires that the most economical forms of energy production be used first.[64] With low domestic fossil fuel resources, and thus high costs for those resources, hydropower is the most stable form of energy available for base-loading the growing power system.[65] Although initial investment in building a dam is usually higher than thermal power plants, the fuel for hydropower (water) is local, renewable, and costs little to nothing.[66] Thanks to the Andes, Chile does have water resource options: it is ranked 20th globally in the availability of water resources,[67] making hydropower an attractive option for both the public and private sectors. Given the high costs of fossil fuels and the apparent availability of water, additional hydropower development is an important consideration for the future needs of Chile, which saw a doubling in electricity prices between 2006 and 2013.[68]

Most of Chile's early dams were built primarily for irrigation and were completed under the auspices of State agencies.[69] However, privatization of the energy sector in Chile, along with the push for further energy development during the last several decades, has resulted in the construction of additional dams for the combined uses of irrigation and hydropower, as well as several

64. *See* Bauer, *supra* note 12, at 620.

65. A shift toward natural gas occurred during the 1990's with the development of combined-cycle technologies and the availability of natural gas from Argentina but economic issues in Argentina and an inability to develop agreements with other South American countries has contributed to price increases for natural gas supplies to Chile. *Id.* at 628.

66. *Id.* at 608.

67. *See* Valdés-Pineda, *supra* note 13, at 2538.

68. Ministerio de Energía, *Agenda de Energía: un Desafío País, Progreso Para Todos*, MINISTERIO DE ENERGIA 12–13 (May 2014), http://www.cumplimiento.gob.cl/wp-content/uploads/2014/03/AgendaEnergiaMAYO2014_FINAL.pdf.

69. *See* Valdés-Pineda, *supra* note 13, at 2546.

dams recently constructed solely for hydropower production by private companies.[70] Although nearly all of the dams recently constructed have been run-of-the-river dams with minimal storage,[71] the increased reliance on water for economic productivity, urbanization, and hydropower, as well as the interactions between them, have made Chile vulnerable to changes in the hydrological cycle.[72]

The most significant difference between Chile and the Columbia River Basin, with respect to water infrastructure is that most of the major infrastructure projects in the Columbia River Basin were the result of massive public investments and continue to be managed by government agencies accountable to the public. In the Biobío Basin, the three largest dams—Ralco, Pangue, and Angostura—were all built, and are owned and operated, by multi-national corporations.[73] Even those projects that were originally public—like the El Toro facility in the Laja River Basin (the Laja is the Biobío's largest tributary)—were privatized in the decades following the 1973 coup.[74] The Chilean infrastructure is thus not subject

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70. *Id.*

71. *See* Carl J. Bauer, *Water Conflicts and Entrenched Governance Problems in Chile's Market Model*, 8 WATER ALTERNATIVES 147, 157 (2015).

72. *See* HILL, *supra* note 11, at 101.

73. Ralco and Pangue are owned and operated by Endesa Chile S.A. Endesa Chile S.A., *Conózcanos: Chile Hidroeléctricas* ENDESA, http://www.endesa.cl/es/conocenos/nuestronegocio/centrales/Paginas/chilehidro.aspx (last visited Oct. 5, 2016). Endesa Chile operates in five South American countries. Endesa Chile S.A., *Conózcanos: Centrales Generados*, ENDESA, http://www.endesa.cl/es/conocenos/nuestronegocio/centrales/Paginas/home.aspx (last visited Oct. 5, 2016). Endesa Chile's majority shareholder is Enersis Chile S.A. Endesa Chile S.A., *Conózcanos: Estructura de Propiedad*, ENDESA, http://www.endesa.cl/en/conocenos/conozcanos/Pages/propiedad.aspx (last visited Oct. 5, 2016). Sixty percent of Enersis Chile's stock is held by the multinational energy corporation ENEL. Bolsa Comercio Santiago, *Stock Summary: Enersis Chile S.A.*, BOLSADESANTIAGO.COM, http://inter.bolsadesantiago.com/sitios/en/mercado/Paginas/Resumen-de-Instrumento.aspx?NEMO=ENERSIS-CH#horizontalTabRI3 (last visited Oct. 5, 2016). Colbún, which owns and operates the Angostura hydroelectric facility, is a publicly traded company operating in Chile and Peru. Colbún, *Interactive Map*, COLBÚN, http://www.colbun.cl/en/energia/mapa-interactivo/ (last visited Oct. 5, 2016). Colbún is owned by a variety of subsidiary corporations. Bolsa Comercio Santiago, *Stock Summary: Colubn S.A.*, BOLSADESANTIAGO.COM, http://inter.bolsadesantiago.com/sitios/en/mercado/Paginas/Resumen-de-Instrumento.aspx?NEMO=COLBUN#horizontalTabRI3 (last visited Oct. 5, 2016).

74. *See* Grantham, *supra* note 21, at 462.

to the same public interest demands as most of the water system in the Columbia River Basin.

With respect to this single element, the Columbia River Basin might seem to be better situated to respond to a changing climate and the hydrological, ecological, and cultural changes that might follow. While there are consistent, and perhaps well-founded, criticisms of government bureaucracy and management, government agencies can better consider the wide variety of communities affected by water resource management. Private corporations, at least under current legal regimes, are not obligated to consider the same range of issues, nor do they have the same management directives and goals.

But it is possible that could change. The United States is no longer in the business of large-scale investments in public works. And, in fact, there are consistent, and consistently loud, voices calling for reduced investments, privatization of public resources, and a greater reliance on private markets generally.[75] In fact, with respect to dam construction, the transition to a reliance on private, rather than public, investment has already occurred.[76]

So, while it is impossible to predict climate change's economic and cultural effects, the United States is already on a multi-decade journey away from the ideals of the New Deal. It is possible, perhaps even likely, that public ownership and control of water resources infrastructure could decline, leading to a future with diminished consideration for the multitude of water-related values and interests affected by management of the Columbia River Basin.

IV. LEGAL REGIMES REGULATING WATER RESOURCES

One interesting aspect of Chile's water resources regime is that it was influenced by economists and other specialists trained in the United States. For those not familiar with water law in the western United States, Chile's water code likely does seem very American, with a focus on private rights and the free market. However, there are significant differences between water regimes in the two countries that have real consequences on the ground. And

75. For an overview of both US and global trends towards neoliberalism *see generally* DAVID HARVEY, A BRIEF HISTORY OF NEOLIBERALISM (2005).

76. *See generally* KARL BOYD BROOKS, PUBLIC POWER, PRIVATE DAMS: THE HELLS CANYON HIGH DAM CONTROVERSY (2006).

those differences are particularly important when there are conflicts between irrigators and the operators of hydroelectric facilities.

A. Prior Appropriation and Dam Building

The western United States presented water allocation problems unknown in the eastern and midwestern states. More than any other feature, the interior West is defined by its aridity. This aridity, combined with wildly fluctuating snow-dominated water flow regimes, yields an inconsistent, and perhaps insufficient, water supply. In addition, the primary economic activities in the early West were mining and irrigation-dominated agriculture. Both activities require moving water from its natural course to the location of use, often far removed from the streambed.[77] The riparian allocation regime used in the East—which grants water rights to the owners of riparian lands—proved incapable of effectively allocating water in western environmental and economic conditions.[78]

Based largely on the extra-legal water codes that developed in mining camps, most states enacted a "first in time, first in right" rule for appropriation of water.[79] This approach assured the first person to appropriate water and apply it to a beneficial use a legal right to continued use of that water. That legal right was crucial in settings that required large investments of time and energy in water infrastructure. However, although prior appropriation does grant significant rights to private individuals, those rights are not unlimited. The rights allocated in a prior appropriation system generally require the continued use of the water as originally appropriated.[80] In other words, the water must be used on the same land, for the same purpose, during the same time period.[81] Changes in use are possible, although difficult, requiring a demonstration

77. WILKINSON, *supra* note 44, at 232.

78. WORSTER, *supra* note 35, at 88–90.

79. *See generally* WILKINSON, *supra* note 44; WORSTER, *supra* note 35. These authors provide descriptions of the development of water law in the Western US.

80. WILKINSON, *supra* note 44; WORSTER, *supra* note 35.

81. WILKINSON, *supra* note 44; WORSTER, *supra* note 35.

that no other water users will be harmed by the change.[82] Therefore, although the system is extremely flexible on the front end, as water (if available) is granted to whomever first puts it to a beneficial use, it is much less flexible later and can respond to changed conditions only with difficulty.

While it served a purpose, prior appropriation has obvious drawbacks, perhaps none more significant than the unnecessarily haphazard way it was implemented on the ground. Charles Wilkinson criticizes this aspect of prior appropriation, saying that it was "*laissez-faire* policy in the extreme; public resources were thrown open to virtually unfettered private exploitation" without any planning or consideration of public or environmental needs. [83] This problem continues today, as water managers have very limited capacity to consider the public interest or ecological services in allocating water during times of shortage—first in time means first in right, even if the use that was first in time is of much lesser public benefit.

Yet despite this criticism, prior appropriation did encourage large water management projects in the form of special irrigation districts, or "corporate-administrative bodies to hold and distribute water."[84] Prior appropriation also attempted to address the extreme fluctuation in river flows in the arid west, by ensuring those that had invested in water appropriation would continue to receive it.[85] However, this oversimplified rule does not take into account the complexity of nature, especially ground and surface water connection, leading to conflict over the "hydrological commons" in many regions, including the Snake River Basin.[86]

While western water law was developing through appropriation and application, planning for water allocation at the basin-scale was also being implemented. General John Wesley Powell

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82. WILKINSON, *supra* note 44; WORSTER, *supra* note 35.

83. WILKINSON, *supra* note 44, at 240.

84. *Id.* at 241.

85. *Id.* at 240–41.

86. MARK FIEGE, IRRIGATED EDEN: THE MAKING OF AN AGRICULTURAL LANDSCAPE IN THE AMERICAN WEST 26 (1999).

was perhaps the first to advocate for basin-scale planning, irrigation, and reclamation projects.[87] His ideas were initially ignored, and political subdivisions largely avoided the more obvious and sensible watershed boundaries in exchange for straight lines and right angles.[88] But ultimately the reality on the ground supported Powell's argument that western water allocation would require large-scale planning and infrastructure development. As discussed above, Congress passed the Newlands Reclamation Act in 1902, which provided funding for the development of large-scale irrigation and hydroelectric projects across the West.[89]

The Reclamation Act enabled a significant social and ecological transformation of western water basins. As Mark Fiege recounts in *Irrigated Eden*, in the early 1900s, irrigation advocates began to promote their vision of an "irrigated Eden," where farmers would "laugh at the cloudless skies."[90] Settlers were already irrigating farmland upstream of American Falls in southeast Idaho in the late 1800s, but the Reclamation Act radically expanded irrigation capacity.[91] Approved in 1904 as one of the first reclamation projects, the Minidoka Project ultimately constructed five storage dams and thousands of miles of canals to irrigate over one million acres of farmland in southern and southeastern Idaho.[92] That development enticed a stream of migrants to the area, and by 1910, the population of Idaho had risen to over 325,000, more than doubling the population of just ten years earlier.[93] These farmers, although at times likely thinking that they were working with nature, were mostly working to radically alter the hydrologic cycle of the

87. *See generally* WALLACE STEGNER, BEYOND THE HUNDREDTH MERIDIAN: JOHN WESLEY POWELL AND THE SECOND OPENING OF THE WEST (1954); WILKINSON, *supra* note 44, at 243.

88. WILKINSON, *supra* note 44, at 243.

89. *Id.* at 243.

90. FIEGE, *supra* note 86, at 11.

91. *Id.*

92. *Id.*

93. *Id.* at 16.

Snake River, as they created hundreds of small dams, ditches, and canals to divert water to their fields.[94]

As the Bureau of Reclamation became more involved, those effects increased by orders of magnitude.[95] From the very beginnings of the modern dam-building era, major dams served two purposes wherever possible—irrigation and hydroelectricity. In the Minidoka Project, the two largest structures—the Minidoka Dam and American Falls Dam—both contain hydroelectric facilities, with the first power from the project coming online in 1909.[96] Across the Columbia River Basin, dam designs incorporated both uses from the beginning. Perhaps the best example is the Columbia Basin Project and massive Grand Coulee Dam, which provide both over 6,000 megawatts of electricity and irrigate almost 700,000 acres of farmland.[97]

From a legal perspective then, the primary elements of the water resources landscape in the Columbia River Basin are prior appropriation and a massive public involvement in irrigation and hydroelectric facilities. Although both elements serve both irrigation and hydroelectricity, which both need secure rights to water that can be stored and used when needed, there is nothing about the uses themselves that are inherently mutually supporting. Water that is being passed through a turbine cannot be stored or diverted from the reservoir for agricultural uses. If water is needed both for storage and power production simultaneously, prior appropriation can allocate water. But since it allocates absolute rights (i.e., *all* of a senior users' rights must be satisfied before the junior can exercise its rights) it cannot *avoid* the conflict. When there is insufficient water to serve both users, one user necessarily will lose.

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94. *Id.* at 17.

95. *Id.* at 19.

96. FIEGE, *supra* note 86, at 19.

97. U.S. Dep't of the Interior, *Columbia Basin Project*, BUREAU OF RECLAMATION, http://www.usbr.gov/projects/Project.jsp?proj_Name=Columbia+Basin+Project (last updated Aug. 27, 2015).

B. Chilean Water Law and the Private Market

Water law in the western United States emerged very early in its settlement history. It also emerged somewhat organically as a reaction to local climatic, hydrological, and ecological needs. Most of western settlement and development occurred after legal structures were in place to allocate water rights.[98] In contrast, although Chilean water law has existed in some form for centuries,[99] Chile enacted its current market-based water code in 1981, well after much of the country had already been developed for agricultural purposes.[100] The code also applies in the same fashion throughout the country, independent of the widely varying local conditions. And Chile's water code was not a reaction to local climatic, hydrological, and ecological needs. Instead, it emerged to serve a particular political agenda that was unrelated to conditions on the ground.[101]

Because Chile developed its current water code at a time when it was reasonable to anticipate large-scale hydropower development, the system distinguished between consumptive rights (water that would be removed from the channel and consumed) and non-consumptive rights (water that would remain in the channel).[102] For example, irrigation is a consumptive right, while rights for hydroelectric facilities are non-consumptive, given that the water theoretically remains within or returns to the watercourse.[103] Of course, some of the water diverted for irrigation returns to the stream, and hydroelectric facilities lose significant amounts of water through evaporation and infiltration from storage reservoirs,[104] so the distinction may be more legal than real.

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98. *See generally* Wilkinson, *supra* note 44; Worster, *supra* note 35.

99. *See, e.g.,* Valdés-Pineda, *supra* note 13.

100. *Id.*

101. *See generally* Bauer, *supra* note 71.

102. *Id.*

103. Codigo de Aguas, Libro Primero, Titulo II, Articulo 14, (Oct. 29, 1981), http://www.leychile.cl/Navegar?idNorma=125984.

104. Reservoirs for 120 largest hydroelectric facilities in the United States lose over 9 billion gallons of water per day. This is the equivalent to the average annual flow of a river the size of the Salmon River in Idaho, or enough water to provide for 10 million families. Hydroe-

The establishment of non-consumptive rights in the Chilean Water Code was specifically intended to promote hydroelectric development, while still ostensibly protecting the consumptive rights of irrigators and other water users downstream.[105] According to Chile's Water Code, non-consumptive rights can be granted after consumptive rights, so long as the use of the water does not prejudice the rights of third parties to the same water, either in quantity or opportunity of use (among other things).[106] Because the largest Biobío dams are relatively new, this provision theoretically should protect the pre-existing rights of downstream irrigators.

But as is often the case, both politics and economics can influence legal reasoning.[107] Conflicts related to the relative priorities of consumptive rights and later non-consumptive rights reached the Chilean Supreme Court in the early 1990's. In 1990, in the Maule River Basin, a new dam (the Pehuenche Hyrdoelectric Plant) had disrupted the water supply to downstream, pre-existing consumptive rights holders. Notwithstanding the statutory provision apparently guaranteeing that non-consumptive uses could not interfere with consumptive rights, the hydropower facility claimed that inherent in the non-consumptive right is the right to fill an associated reservoir allowing use of the non-consumptive right, whatever the impact on downstream users. The lower courts found for the downstream users on several occasions, but the Chilean Supreme Court repeatedly overturned those lower court decisions

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lectric facilities use, on average, 40 times more water per kilowatt hour produced than do thermoelectric generating facilities. *See* P. Torcellini, N. Long, & R. Judkoff, *Consumptive Water Use for U.S. Power Production*, NREL 4 (Dec. 2003), http://www.nrel.gov/docs/fy04osti/33905.pdf.

105. *See* Thomas Coleman, *Who Owns the Water? An Analysis of Water Conflicts in Latin American and Modern Water Law*, J. OF THE COMP. HIST. IDEAS PROGRAM 12 (2012), https://depts.washington.edu/chid/intersections_Spring_2012/Thomas_Coleman_Water_Conflicts_in_Latin_America_and_Water_Law.pdf.

106. *See* Codigo de Aguas, *supra* note 103.

107. *Id.*

while refusing to rule on the crucial substantive issue regarding priority.[108]

In a subsequent case challenging water use by the Pangue Hydroelectric Facility on the Biobío, the Chilean Supreme Court finally confronted the substantive issue.[109] Pangue was much more controversial than the Pehuenche facility in the Maule Basin, in part because it would displace, and have significant effects on native Pewenche communities.[110] Opponents argued that a non-consumptive right did not include the right to alter water flows without concern for the effects on downstream consumptive rights holders.[111] The Chilean Supreme Court, ignoring its previous support for the property rights of irrigators, and the apparently clear language of the statute, ruled in favor of the hydroelectric facility.[112]

Combined, these cases potentially demonstrate an apparent judicial preference—at least in the early 1990s—for hydroelectric facilities over irrigation, notwithstanding the apparent requirements of the Water Code. The first case on the Maule River involved a large, conventional reservoir dam with a storage capacity of 1,544 million cubic meters of water.[113] After dam construction was complete, the dam gates were completely closed to fill the reservoir in November (Chilean irrigation season), which completely

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108. For a more detailed discussion of this case, see CARL J. BAUER, SIREN SONG: CHILEAN WATER LAW AS A MODEL FOR INTERNATIONAL REFORM 106–09 (2004); *See also* Coleman, *supra* note 105, at 15–16.

109. *See* Corte Suprema de Justicia [C.S.J.] [Supreme Court], 8 mayo 1993, "Orrego c. Empresa Eléctrica Pangue" (Chile).

110. *See id.* The Ralco hydroelectric project, which was constructed a few years after and upstream from Pangue, was even more controversial. Unlike Pangue's run-of-the river operation, Ralco created a large reservoir which flooded an ancient Pewenche cemetery. There were numerous violent clashes between the government and Pewenche protesters during construction. A 2014 Spanish-language documentary of the conflict is available on YouTube. *Quintremán - Crecer con Sabiduría* (Grow with Wisdom), YOUTUBE (2014), http://youtu.be/Mueva9ztV8A.

111. *See* Coleman, *supra* note 105, at 16.

112. *See* BAUER, *supra* note 108, at 109–11; *see also* Coleman, *supra* note 105, at 16.

113. *See* Valdés-Pineda et al., *supra* note 13, at 2546. This is approximately the storage capacity of Palisades Reservoir in the Upper Snake River Basin. *See* U.S. Dept. of Interior, *Pacific Northwest Region Storage Reservoirs in the Upper Snake River Basin*, BUREAU OF RECLAMATION, http://www.usbr.gov/pn/hydromet/burtea.html (last updated Nov. 20, 2015).

cut off all flow in the river to downstream users.[114] Downstream water users thus suffered an obvious and clear harm, but the Chilean Supreme Court refused to "rule on the issue and persuaded both parties to settle the matter through private arbitration."[115] Thus, notwithstanding what appeared to be a violation of the Water Code resulting in an obvious economic harm, the Supreme Court left the downstream irrigators without a legal remedy.

The conflict at the Pangue Dam reinforces this sense that the Chilean government preferred hydropower. Pangue sits relatively high on the Biobío, above all of the irrigators in the basin. [116] It is also designed exclusively for hydropower, [117] as a run-of-the-river operation[118] with 175 million cubic meters of storage capacity.[119] Once operational, run-of-the-river operations have relatively limited effects on downstream water supply.[120] Although day-to-day peaking operations can cause rapid fluctuations in flows, the primary impact of Pangue on the water supply available to downstream users would have been when the reservoir was initially filled.[121]

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114. *See* Coleman, *supra* note 105, at 15. Minimum ecological flows for new dam projects were not required until the passage of the 2005 Water Code Amendments. Borzutsky & Madden, *supra* note 2, at 258.

115. *See* Coleman, *supra* note 105, at 15.

116. A map of all irrigation canal systems in the Region can be found on the Chile Department of Agriculture's Natural Resources Information Center website. Ministerio de Agricultura, *Red de Canales Región del Bío-Bío, CIREN,* http://comercial.ciren.cl/images/pdf/PDF_VIII/red_canales_08.pdf.

117. *See* Valdés-Pineda et al., *supra* note 13, at 2546.

118. "Run-of-the-river hydropower plants have the lowest operating costs. Since the water flowing by or through them cannot be stored, it must be used or it is lost. As a result, these generators are always operating whenever there is water. They provide part of the SIC's baseline power supplies." *See* Bauer, *supra* note 12, at 621.

119. Although Pangue is a large structure, at 113 meters tall, its reservoir is relatively small. It has approximately the storage capacity of Island Park Reservoir on the Henrys Fork in the Upper Snake River Basin, but it can only story 12% of the capacity of Palisades Reservoir or 8% of the capacity of American Falls Reservoir, both on the Snake River.

120. Bauer, *supra* note 12, at 608.

121. *See generally* García et al., *Downstream Environmental Effects of Dam Operations: Changes in Habitat Quality for Native Fish Species* 27 RIVER RES. & APPLICATIONS

In 1993, when the Supreme Court was hearing the case, the dam was not yet constructed. Thus, unlike the Colbún conflict, where the dam had already caused demonstrable harm, with Pangue, the irrigators were arguing about potential loss of water in the future.[122] As a run-of-the-river dam with a small reservoir, Pangue lacks the capacity to store large quantities of water. Thus, unlike more predictable storage reservoirs in snow-dominated systems, those which capture and release water on somewhat more knowable schedules, Pangue would have potentially significant effects on downstream water users at sporadic and unpredictable times, as it alters river flows on a day-to-day or week-to-week basis to take advantage of favorable market conditions.[123] Because Chilean water use conflicts fall under civil law, rather than administrative law, the burden of proof to demonstrate harm was on the downstream irrigators.[124] Relying on reports from the Dirreción General de Aguas, the Chilean administrative agency tasked with managing the water rights system, the Chilean Supreme Court determined that any potential effects were questionable and uncertain.[125] The court did determine that irrigators could bring damages claims later, should damages arise.[126] But the limited storage capacity of a run-of-the-river dam, and thus the relatively limited, unpredictable, and inconsistent effects on water flow, and perhaps the geographical layout –which includes multiple large tributaries downstream of Pangue that contribute to and alter the river's flow regime –potentially make demonstrating those future damages difficult.

Combined, these cases suggest a potential preference for hydroelectric development over irrigation uses. The Court refused to acknowledge a clear, present harm, and even when it recognized harm that might occur, it put off considering that harm to a point

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(2011) for a demonstration of hydro-peaking in the Biobío River upstream of the irrigators due to the operations of the dams.

122. *See* Corte Suprema de Justicia [C.S.J.] [Supreme Court], 8 mayo 1993, "Orrego c. Empresa Eléctrica Pangue," (Chile).

123. *See generally* Garcia, *supra* note 121.

124. *See* Bauer, *supra* note 12, at 599.

125. *See* Coleman, *supra* note 105, at 16.

126. *Id.*

at which it might be difficult to prevent or remedy. But it is important to note that these cases occurred at a time of political transition.[127] General Pinochet had only given up the presidency a few years earlier, in 1990, and remained in charge of the country's military.[128] Many of the country's judges and justices would have been benefactors of the Pinochet regime and might have felt pressures from a number of sources to continue the policies of that regime. But while the politics of these decisions certainly suggest a continued preference for hydropower development, neither the Colbún nor Pangue decisions necessarily have any legal effect on future conflicts. In the Chilean civil law system, case law precedent has a different effect than it does in the United States.[129] The Chilean Supreme Court is not bound by its previous decisions in the same fashion, and the Court's opinions may evolve more readily over time.[130] More recent Supreme Court rulings suggest that the Chilean Supreme Court may be willing, now that it is more distanced from the Pinochet regime, to carefully consider public rights. Two recent cases, although not dealing with hydroelectric facilities, nor addressing conflicts over consumptive versus non-consumptive rights, provide evidence of a potential transition in the Chilean Supreme Court's approach to water resource disputes.

For example, in Chile's Coquimbo Region, about 150 miles north of Santiago, the El Mauro tailings dam blocks the Pupio River. The dam is just upstream from a small community of Caimanes, with approximately 2,000 inhabitants.[131] In 2008, citizens of Caimanes brought a claim before the courts that the ongoing construction of El Mauro[132] affected both the quantity and quality

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127. Bauer, *supra* note 71, at 151.

128. *Id.*

129. *See* Pablo Bravo-Hurtado, *Hacia los precedentes en Chile: Reforma procesal civil y fuentes del Derecho*, 40 REVISTA CHILENA DE DERECHO 549 (2013).

130. *Id.*

131. *See* Florian Lehne, *Caimanes and the Water-Infinite Legal Struggles about a Finite Good,* 3.1 FUTURE OF FOOD: J. ON FOOD, AGRIC. & SOC'Y 94–95 (2015).

132. *Id.* at 97 (The tailings dam has been in place for decades. One interesting aspect of the case is that it required characterization of the dam as a "new construction." The Chilean Supreme Court determined that, because tailings are continually added, it constitutes new construction).

of their water.[133] In 2014, the Chilean Supreme Court issued a ruling that the defendant, Los Pelambres, S.A., was required to restore the natural course of the water in the Pupio Valley.[134] Although this case is about water and the effects of the dam on the ability of the citizens of Caimanes to use the water, it was grounded primarily in Chile's environmental laws, rather than in its water code.[135] The Court used water pollution, rather than water rights, to find for Caimanes.[136] It is of note then that in April 2015, an appellate court in La Serena determined that the tailings dam *was not* polluting water used in Caimanes.[137] An appeal of the original order to remove the dam remains pending,[138] but, because the original case was about water quality (rather than quantity), this later finding could defeat the citizens' claims.

Another recent water rights dispute in the semi-arid region of Northern Chile pitted indigenous communities against a private water bottling company, Agua Mineral Chusmiza SAIC.[139] The indigenous communities contended that the company's use of water was depriving them of their water rights under the International Labour Organization Convention 169 (Indigenous and Tribal Peoples Convention), ratified by Chile in 2008.[140] Although the company's rights were registered and communities' rights were not, in 2009 the Supreme Court granted part of the flow to the indigenous

133. *Id.* at 96 (The applicants further argued that the dam was "hampering the community be creating a considerable risk for the maintaining of natural resources, mainly the human consumption of drinking water and the use of water as means of production, thereby perturbing natural riverbeds and affecting social goods…, as is living in an environment free from contamination guaranteed by Article 19 No. 8 Chilean Constitution").

134. *See id.* at 97.

135. *See id.* at 98.

136. *Id.* at 97–98.

137. *Chile Court Rules Tailings Dam for Antofagasta's Los Pelambres Mine Safe*, REUTERS (Apr. 22, 2015), http://af.reuters.com/article/metalsNews/idAFL1N0XJ31J20150422.

138. *Id.*

139. *Agua Mineral Chusmiza Lawsuit (re Chile)*, BUS. & HUMAN RIGHTS RES. CTR., http://business-humanrights.org/en/agua-mineral-chusmiza-lawsuit-re-chile (last visited Sep. 14, 2016).

140. *Id.*

communities under the ILO Convention and the Chilean Indigenous Peoples' Act, recognizing their ancestral water rights, while also recognizing the co-existent rights of the company under the Water Code.[141] Although unrelated to dams, this ruling also affirmed the rights of downstream communities to claim water, and it empowered indigenous rights, despite a potential impact to economic development.

These two cases do not address conflicts between hydroelectric facilities and irrigators, nor do they address the question of priority between consumptive and non-consumptive rights.[142] And both cases are grounded primarily in other legal regimes, rather than in the Water Code alone.[143] Thus their capacity to suggest a new approach to resolving conflicts like Pangue and Colbún is somewhat limited. But notwithstanding those differences, the cases do demonstrate that the Chilean legal system is beginning to take a more holistic approach to addressing economic development and environmental harm. They also suggest that the Court may have moved past its early-1990s discomfort with addressing water or environmental issues.

Although the distinction—or more accurately, the application of the distinction—between consumptive and non-consumptive uses is, to some extent, at the heart of the conflicts between irrigators and hydroelectric facilities, it is not the only interesting aspect of Chile's Water Code. In fact, there are aspects of the Chilean water rights system that might provide some flexibility in the future as the country tries to address changing hydrological, ecological, and climatic conditions.

When the new Water Code was first enacted in Chile, the DGA was authorized to approve all water rights applications, without fees, as long as the water was legally unclaimed and physically available, regardless of the intended use.[144] Whenever two or more requests are received for the same water right simultaneously, a

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141. *Id.*

142. *See id.*

143. *See id.*

144. *See* Coleman, *supra* note 105, at 14.

public auction is held,[145] and the DGA cannot privilege one use or user over another in the process.[146] Once granted by the DGA, these private property rights can "be bought, sold, transferred, rented, or inherited at the owner's discretion,"[147] as well as mortgaged like other real estate.[148] Unlike water rights laws in the western US, there is no "use it or lose it" requirement,[149] nor is there a "beneficial use" requirement.[150] There is also no tax or fee for either the water right or use, and the type of use can almost always be changed at any time without notification or approval by the DGA.[151] As noted previously, the goal of this system was to create a private market in water rights.

At least in the abstract, the benefit of Chile's private market approach is that it allows water rights to be transferred to the places and uses where they will be of most economic value, with the opportunity for low transaction cost trading and the quick responses needed to adapt to fluctuations in water availability.[152] But in practice, Chile's water markets only operate in specific areas under a narrow set of cultural and economic conditions, and the theoretical benefits of private water markets have not emerged.[153] In fact, most assessments of the system have been critical, from a variety of perspectives.[154] However, legal reforms in

145. *See* José Ignacio Morán, *Water Legislation in Chile: The Need for Reform*, http://global.practicallaw.com/cs/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1247756543247&ssbinary=true.

146. *See* Paul Lewin, *Análisis de la Eficiencia del Mercado de Derechos de Aprovechamiento de Aguas en Chile*, SANTIAGO 9 (Enero 2003), http://econwpa.repec.org/eps/othr/papers/0503/0503005.pdf.

147. *See* Coleman, *supra* note 105, at 14.

148. *See* Bauer, *supra* note 12, at 598.

149. *See* Morán, *supra* note 145.

150. *See* Bauer, *supra* note 12, at 599.

151. *Id.*

152. *See* Borzutzky & Madden, *supra* note 2, at 259–66.

153. *See id.* at 258.

154. *See id. See also* Clarvis, *supra* note 9; Bauer, *supra* note 12.

2005 removed some of the obstacles to active water markets,[155] and the level of autonomy provided for individual rights-holders in Chile provides for the potential economic freedom necessary to pursue water trading should conditions allow.[156] Thus, although the Chilean water system has yet to achieve the efficiency first imagined when it was first created by neoliberal economists in 1981, it does appear that some flexibility does exist to react to changing conditions, even if this flexibility has yet to be realized in any significant way. Of course, as is the case with all market-based systems, values such as environmental or cultural values that are difficult to account for, or perceive of economically, could lose out in this system.

This market-based approach is not the only way in which the Chilean system attempted to create flexibility. In apparent contrast to the overall, do-whatever-you-want-with-your-right approach suggested above, the Water Code created many different types of water rights classifications beyond consumptive and non-consumptive distinction discussed previously. Water rights can be classified as permanent, eventual (when there is surplus),[157] continuous (uninterrupted), discontinuous (periodic), or alternating (when two or more users take turns).[158] Any of these rights can also be further partitioned among several users and/or split with respect to continuity so that each user holds a right to discontinuous use.[159] One other category, provisional rights, exists for restricted zones, which require proof of no impact to the water supply for a period of five years before the DGA will convert them to permanent rights.[160] All of these rights are measured in volume per unit time.[161] As climate change reduces the availability of water, it is

155. *See* Borzutzky & Madden, *supra* note 2, at 256–59.

156. *See* Hill, *supra* note 11, at 302.

157. Article 18 of the Water Code expressly prohibits eventual rights from being allocated for reservoirs. *See id.* at 142.

158. *See* Valdés-Pineda, *supra* note 13, at 2549.

159. *See* Lewin, *supra* note 146, at 8.

160. *See* Hill, *supra* note 11, at 142.

161. *See* Lewin, *supra* note 146, at 7.

possible that these various rights categories could create opportunities to improve the efficiency in water use and reduce the impact to individual water users.

Unlike most water allocation regimes in the Western United States, where a state agency or specialized court manages water rights, the Chilean system is much more decentralized. The DGA performs functions for water basins such as planning, investigation, protection, and development, as well as the granting of water rights and approval of major hydraulic works.[162] However, their role in the management of water use is limited to cases of extreme drought, when they are able to intervene in water distribution for a maximum, non-renewable, period of six months.[163] Instead, private local water use organizations (WUO), which have existed for about 200 years, manage water resources, resolve conflict, and facilitate water trading among members on a local scale.[164] These organizations also share costs for the construction and maintenance of infrastructure, while facilitating communication and trading activity.[165]

The Chilean WUOs are very similar to the canal companies, irrigation districts, traditional acequias, Mormon cooperatives, or other similar cooperative efforts that have been used across the Western United States. In times of short-term water shortage or inter-day variability, the WUOs are able to adapt through local

162. *See* Morán, *supra* note 145.

163. *See id*. Resolution No.674 (2012) establishes the parameters under which the DGA can recommend that a drought period (not to exceed 6 months) be declared by the President under Article 314 of the Water Code. Under these conditions, the DGA can redistribute water and authorized additional ground and surface water withdrawals, without rights, in order to minimize the damage of the drought. Any rights-holder that is affected by the redistribution is entitled to indemnification under Article 314. Resolution No. 674 replaced and modernized Resolution No. 39 (1984) by establishing new criteria for each Region in Chile, and explicitly referenced climate change and advances in science and technology as reasons for the new version.

164. Three types of WUO are formally recognized in the Water Code, Canal Associations (Asociones de Canalistas), Supervisory Councils (Juntas de Vigilancia), and Water Communities (Comunidades de Agua). Canal Associations (primarily irrigation) and Water Communities (other uses) are formed by two or more users that share the same artificial water diversion system, whereas Supervisory Councils are made up the various users and user organizations within the same water basin. *See* Morán, *supra* note 145; *See also* Valdés-Pineda, *supra* note 13, at 2553.

165. *See* Borzutzky & Madden, *supra* note 2, at 261.

management mechanisms.[166] One traditional Spanish system that is implemented both at the canal and basin level is known as Turno, which proportionally reduces the amount of water for each rights holder by allocating water in shifts over a certain time period.[167] In addition, any water rights transactions that may take place within the same Canal Association or Water Community, whether temporary or permanent, can immediately be approved and implemented directly by the management of the Association or Community.[168] Subsidized loans are also available for the improvement of existing infrastructure (e.g., lining canals to improve efficiency), as well as for the construction of new water infrastructure to be operated and maintained by the WUOs.[169] Some WUOs have also retrofitted irrigation canals with small hydropower turbines through private investment in order to increase revenues for improvement projects, such as those geared toward climate change adaptation.[170] The primary difference with the Chilean approach is that there is very limited government oversight or control of these WUOs. In contrast with the Western United States, where cooperative organizations are authorized by law to work within a highly regulated system, the Chilean WUOs are a reaction to the *lack* of a regulatory or other (e.g., market-based) effective structure that could allocate resources in times of scarcity.

On first glance, it might seem that it is Chilean law that is to blame for the conflicts between consumptive and non-consumptive uses, between irrigation and hydropower. At least as presently configured and operating, the market-based approach has proven incapable of managing large-scale conflict, even if it has proven somewhat successful on smaller scales or in specific locations. In a prior appropriation system, like that used in Idaho, the question of whose rights must be satisfied first is relatively straight forward—first in time, first in right. So arguably, if Chile would adopt a priority system more similar to that of western States, it might avoid this or similar problems in the future. Of course someone would lose, but the legal conflict would be straightforward. But it is not

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166. *See* Hill, *supra* note 11, at 193.

167. *Id.*

168. *See* Lewin, *supra* note 146, at 9.

169. Additional financing for adaptation is also available through the DGA as a result of drought declarations. *See* Hill, *supra* note 11, at 260–261.

170. *See* Bauer, *supra* note 12, at 642.

our law that makes the U.S. system work somewhat better in allocating water between irrigators and hydroelectric facilities. Chile's law would probably work well if Chile were like the western U.S. in other, non-legal ways.

Despite recent international controversy about the Biobío, it remains a relatively undeveloped basin by U.S. standards. The main stem of the Biobío has only three major dams, the newest of which has been operating for just two years. While the total storage capacity of the system is apparently unknown, the two largest dams—Pangue and Ralco—can only capture about 5% of the Biobío's total runoff. In contrast, almost 100% of the annual runoff can be captured in the Sacramento River system. And in the Upper Snake River, the reservoirs capture over 80% of historical average flows.

These higher storage capacities in the United States reflect systems designed for irrigation as much as hydropower, particularly on the Snake River. The major dams on the Upper Snake were built by the Bureau of Reclamation, with the purpose of constructing "irrigation works for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands" in the western United States.[171] But even with that primary focus, dams in the western United States incorporated hydropower from the very beginning as integral components of the overall water allocation system. Thus water managers could address potential conflicts from the very beginning, when the rights were first allocated.

In Chile, in contrast, the dams are primarily (and exclusively in some cases) hydropower facilities. And those hydropower facilities were all built relatively recently, after Chile's agricultural economy had largely developed and water had been claimed for centuries. And these dams did not have the goal of promoting ag-

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171. 43 U.S.C. § 391 (1902) (as amended by Pub. L. No. 114-221 (2016)). The dams on the Upper Snake River are part of the Minidoka Project, first authorized in 1904 under authority granted the Secretary of the Interior in the Newlands Act. Of the five original dams in the Minidoka Project, three were intended exclusively for irrigation purposes. The other two provided for both irrigation and power production. A history of the Minidoka Project is available at the Bureau of Reclamation's website: *Minidoka Project*, BUREAU OF RECLAMATION, http://www.usbr.gov/projects/Project.jsp?proj_Name=Minidoka+Project (last visited March 3, 2015).

riculture in an arid environment. Finally, and critically, Chile's hydropower facilities are private, built with private funds for private purposes.[172]

Thus as we compare the legal regimes in the Columbia River Basin and Chile, we should acknowledge that part of the reason we seem to avoid conflicts between irrigators and hydroelectric facilities as severe as those in Chile is that we have already built a lot of dams, specifically for irrigation. Thus, we have already endured conflict and caused the ecological and cultural harms that Chile might still be able to—and might want to—avoid. As noted previously, the run-off storage capacity of the Upper Snake River infrastructure is many times that of the Biobío, providing—at least from one perspective—"more" water to allocate among the competing users.[173] The Columbia River Basin also benefitted from particular economic and settlement conditions that allowed for the irrigation and hydropower, such that most hydroelectric facilities in the American West have served those two purposes from the beginning.[174] It is not a fundamental component of our legal system that is better able to resolve conflict. It is, to some extent, something of a historical accident that our prior appropriation system works as well as it does.

In fact, one of Idaho's most significant historic conflicts between irrigators and a hydroelectric facility might best demonstrate these points. In 1983, the Idaho Power Company sued 7,500 upstream irrigators in a dispute over the water supply at its Swan Falls dam.[175] The Swan Falls dam had water rights dating to 1900,[176] while a significant proportion of water rights in the Upper Snake River were associated with later Newlands Act and Carey

172. *See* Valdés-Pineda, *supra* note 13, at 2546.

173. Stream flow data at Howell's Ferry near Minidoka dates to April 1910. *See USGS 13081500 Snake R NR Minidoka ID (At Howell's Ferry)*, U.S. GEOLOGICAL SURVEY, http://waterdata.usgs.gov/nwis/inventory/?site_no=13081500 (last visited Sep. 14, 2016).

174. DONALD WORSTER, RIVERS OF EMPIRE: WATER, ARIDITY, AND THE GROWTH OF THE AMERICAN WEST 123 (New York, NY: Oxford University Press, 1992).

175. For a detailed discussion of the Swan Falls controversy, *see* Jeffrey C. Fereday & Michael C. Creamer, *Swan Falls in 3-D: A New Look at the Historical, Legal and Practical Dimensions of Idaho's Biggest Water Rights Controversy*, 28 IDAHO L. REV. 573 (1992).

176. *Id.* at 580.

Act projects.[177] Thus, the lawsuit threatened to restrict irrigation on thousands of acres.

While some of the conflict's effects were significant,[178] the Swan Falls Agreement ultimately allowed continued irrigation upstream of Swan Falls.[179] But it was not some element inherent in our institutional regimes that provided a pathway to resolve the conflict. In fact, it was the strict application of the prior appropriation doctrine that caused the conflict in the first place—Idaho water law did not have a mechanism for adapting to changing climatic or water use regimes. Rather, it was the overall system's *physical* flexibility, due both to its natural and constructed elements (including sufficient available water at the time),[180] as well as the political power of the irrigators, that created an agreement that continues working today—an agreement developed *outside* of the confines of prior appropriation. That flexibility was provided in large part by the massive public investment in water infrastructure in upper parts of the river, rather than by the legal regime itself. But that flexibility, and even the political conditions benefitting irrigators, might not exist to help resolve conflicts in the future.

V. ENVIRONMENTAL VALUES AND CONNECTIONS TO THE NATURAL WORLD

While the obvious geographical, historical, and legal differences are important, more subtle are some significant differences between Chile and the Columbia River Basin, particularly the ones that might have something more to teach us about how water resource regimes in the Columbia River Basin might be able to adapt in a changing climate. One of the differences between the Biobío and our rivers is that although the Biobío is the most biodiverse of

177. WORSTER, *supra* note 174, at 157–60.

178. The most obvious effect was the initiation of the Snake River Basin Adjudication. Fereday & Creamer, *supra* note 175, at 593.

179. *Id.*

180. One indication of that structural flexibility is the fact that the mean monthly flows at the Murphy gauge on the Snake River, in August, apparently have never dropped to the required minimum flows established by the Swan Falls Agreement. These flows have remained even as development has continued upstream. Data for the Murphy gauge is available at: *USGS 13172500 Snake River NR Murphy ID,* U.S. GEOLOGICAL SURVEY, http://waterdata.usgs.gov/usa/nwis/inventory/?site_no=13172500 (last visited Sept. 14, 2016).

Chilean rivers,[181] it lacks the iconic native fishes found in western streams. Most of the native fish are small and largely unknown. The largest native fish is a homely species of catfish, reaching about eighteen inches in its largest examples. There are no native fishes valuable from either a commercial or cultural perspective. Although the native Pewenche[182] people of the upper Biobío are considered a "sociedad ribereña" (a riverine society), they rely on the pine nuts of the native Pewen[183] tree for both alimentary and spiritual sustenance. Their connection to rivers or fish is different from that of native peoples in the Pacific Northwest.

Although some authors have pointed out that the salmon has not always been, nor is it necessarily even now, a cohesive cultural symbol, or "regional marker" for the Pacific Northwest region as a whole,[184] salmon have played a pivotal role in the controversies over the region's economy and development. This has included the legal implications of both an indigenous rights movement to reclaim salmon as a first food and treaty right, and the listing of several salmon species under the Endangered Species Act (ESA). The presence of salmon within the Columbia and Snake Rivers has profoundly affected the management and regulation of water resources.

In the Columbia, salmon act as powerful agents, having far-reaching effects on water management through Tribal treaty rights and the ESA. Tribes have lived and fished along the Columbia and Snake Rivers since time immemorial, consuming up to 60%

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181. While the Biobío is biodiverse by Chilean standards, it is much less biodiverse than the Columbia River Basin. The Columbia River Basin is home to thirty-one native fishes and twenty-six introduced fishes, many of which provide sport fishing opportunities. In contrast, the Biobío is home to seventeen native fishes and four introduced species. *See* Evelyn Habit et al., *Response of the Fish Community to Human-Induced Changes in the Biobío River in Chile*, 51 FRESHWATER BIOLOGY 1 (2006).

182. Although this is the spelling used by the Pewenche themselves, their name is also often spelled "Pehuenche" (with the same pronunciation).

183. Also called the Araucaria or monkey puzzle tree -- *Araucaria araucana*.

184. John M. Findlay, *A Fishy Proposition: Regional Identity in the Pacific Northwest, in* DAVID M. WROBEL AND MICHAEL C. STEINER, MANY WESTS: PLACE, CULTURE, & REGIONAL IDENTITY 37 (Kansas: University of Kansas Press, 1997).

of their diet in calories from salmon.[185] But beyond being a critical food source, salmon hold important spiritual and cultural significance, providing connections between family members, intergenerational tradition, and a way of life that has nurtured both physical and mental health.[186] Salmon numbers began to decline in the late 1800s, with the introduction of industrial-scale fishing and canning, the destruction of habitat, and a failed hatchery program.[187] Yet major dam development along the Columbia and Snake Rivers contributed to a loss of key fishing sites through inundation and blocked the migration of salmon runs, in many cases decimating runs to the point of extinction, especially in important, upriver fisheries. Despite these devastating losses, tribes in the Pacific Northwest are reasserting their treaty-given rights to fish at "usual and accustomed places."[188] These rights were fought for and won in several cases spanning the 1960s and '70s, including: *Sohappy v. Smith*[189] and *United States v. Oregon*[190] in which the courts found that treaty rights to fish off-reservation were absolute, and *United States v. Washington,*[191] in which Native American tribes were found to be entitled to up to 50% of harvestable fish. In the Biobío, the rights of indigenous peoples are only beginning to be realized, but with profound effects.

The lack of an iconic, culturally-important, fish species might initially seem like a benefit to Chilean water managers, because it would seem to simplify integrated watershed management, relative to our experiences in the Columbia River Basin. But in many ways the opposite is true. If the ultimate goal is a river system that works for all of its inhabitants, providing cultural, ecological, hydropower, flood control, and irrigation benefits, then salmon and

185. Mary L. Pearson, *The River People and the Importance of Salmon*, *in* BARBARA COSENS, THE COLUMBIA RIVER TREATY REVISITED: TRANSBOUNDARY GOVERNANCE IN THE FACE OF UNCERTAINTY 70 (Corvallis, OR: Oregon State University Press, 2012).

186. *Id.* at 71.

187. *See* JOSEPH E. TAYLOR III, MAKING SALMON: AN ENVIRONMENTAL HISTORY OF THE NORTHWEST FISHERIES CRISIS 137-40 (Seattle, WA: University of Seattle Press, 1999).

188. Treaty with the Yakamas, U.S.-Yakama, art. III, Jun. 9, 1855, 12 Stat. 951.

189. State v. Sohappy, 757 P.2d 509 (Wash. 1988).

190. United States v. Oregon, 718 F.2d 299 (9th Cir. 1983).

191. United States v. Washington, 384 F. Supp. 312, 343 (W.D. Wash. 1974).

steelhead provide a useful focal point around which to engage in conversation and compromise. Salmon and steelhead have helped ensure continued political power and cultural relevance for native peoples. They provide reason for casual participants to care about river and ecosystem management. Salmon and steelhead complicate management, to be sure, but also provide a reason for that management. While we might disagree about the best route to get there, we all care about the survival of anadromous fish populations. That focal point is missing in the Biobío.

This is not to say that the absence of an iconic fish species, or some other environmental condensation point,[192] prevents Chileans from developing connections with the natural world and thus seeking to protect or effectively manage it. Although the development of legal regimes in Chile to protect the natural environment occurred relatively recently, the country has made significant progress.[193] Environmental protection was formally connected to water resources in Chile in the early 1990's with the passing of the Environmental Law and the System of Environmental Impact Assessment (SEIA).[194] Chile's first environmental agency (CONAMA), now the Ministry of Environment (MMA), was also created to manage EIAs for projects such as mines and dams.[195] The Law established the "right to a clean environment and protection of the environment," as well as the right to environmental information held

192. In this context, a "condensation point" is a particular resource conflict, or other moment in time, that causes all of the various constituencies to focus on a particular issue. *See, e.g.*, Peter B. Nelson, *Rural Restructuring in the American West: Land Use, Family and Class Discourses*, 17 J. Rural Stud. 395, 400 (2001).

193. See, for example, Chile's recent decision to reject the large HidroAysén hydroelectric project in Southern Patagonia. Brian Clark Howard*, Chile Scraps Huge Patagonia Dam Project After Years of Controversy,* NAT'L GEOGRAPHIC, Jun. 10, 2014, http://news.nationalgeographic.com/news/energy/2014/06/140610-chile-hidroaysen-dam-patagonia-energy-environment/.

194. *See* Morán, *supra* note 145, at 2.

195. *See* Barandiaran, *supra* note 51, at 9.

by authorities, and required that public participation and environmental education campaigns be facilitated by the State.[196] Furthermore, the SEIA established the primary mechanism for direct public participation in project development.[197]

In addition, amendments to the Water Code in 2005 established a minimum ecological flow requirement for new water rights allocations,[198] although the minimum flow requirement does not apply to rights established prior to 2005. The 2005 amendments also grant the President the ability to establish ecological flows (to a limited amount) and reserve flows in any basin, as long as they do not affect third party rights.[199] The President also has the discretionary power under the legislation to remove water rights from the market to protect public interest.[200] The 2005 amendments also require the DGA to develop quality standards for both surface and groundwater.[201]

In addition to these steps forward, Chile has recently enacted a new law for public participation that goes beyond the framework in the EIA in requiring each agency to formalize a specific method for people and organizations "to participate in policies, plans, programmes [sic] and actions."[202] Chile has also actively adopted international environmental conventions, "such as the United Nations Convention on Climate Change; the United Nations Convention to Combat Desertification; the Convention on Conservation of Biodiversity, the Ramsar Convention to protect wetlands; [and] the Washington Convention to protect National Parks and Scenic Values."[203] With these new rules in place, the DGA now has broader authority to block or stall undesirable projects with environmental

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196. *See* Hill, *supra* note 11, at 143.

197. *See id.* at 148.

198. *See* Morán, *supra* note 145, at 2.

199. *See* Valenzuela Christian, Rodrigo Fuster, & Alejandro León, *Chile: Is the Fee for Non-Use of Water Rights Effective?* 109 CEPAL REVIEW 163, 184 (2013).

200. *See* Borzutzky & Madden, *supra* note 2, at 257.

201. *See id.* at 258.

202. *See* Hill, *supra* note 11, at 148–149.

203. *See* Valdés-Pineda, *supra* note 13, at 2551.

concerns by denying new rights for such projects based on environmental preservation, auctioning rights among parties in conflict, or continuously requesting additional impact studies.[204]

The Biobío provides an excellent example of the effect of Chile's changing attitude toward the natural environment, but in a situation that might have appeared initially to have been a failure. The Ralco Hydroelectric Plant was first proposed for an area high in the Andes region on the Biobío in 1994.[205] It was ultimately completed in 2003 amid heavy national and international criticism.[206] Ralco was designed as a 578 MW reservoir-type dam upstream of Pangue, with 1,174 million cubic meters of water storage—at least ten times larger than any other artificial reservoir in the Region.[207] However, unlike the Pangue project, downstream irrigators were not part of the conflict, likely due to the fact that the Ralco project was specifically designed to provide summertime flow in order to keep Pangue operable during the dry season, which benefitted agriculture.[208] However, the project required the flooding and destruction of 3,500 hectares of traditional territories and native forests of the indigenous Pewenche Peoples, named for the native Pewen (pine nut) tree that represents their fundamental First Food, similar to the role of salmon in the Northwest United States.[209] The project also required the relocation of 675 people, most of whom were Pewenche.[210]

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204. Several examples for each mechanism are provided. *See* Borzutzky & Madden, *supra* note 2, at 258–259.

205. Ted Warren, *More than a dam – a story behind Ralco*, WATERPOWER MAGAZINE, Aug. 11, 2009, http://www.waterpowermagazine.com/features/featuremore-than-a-dam-the-story-behind-ralco/.

206. *Id.*

207. There is a natural lake (Laja Lake) in the Biobío Region that is directly used as a hydropower reservoir. The lake can theoretically store over 5,000 Mm3 of water. *See* Valdés-Pineda, *supra* note 13, at 2546.

208. *See* JOSÉ AYLWIN, THE RALCO DAM AND THE PEHUENCHE PEOPLE IN CHILE: LESSONS FROM AN ETHNO-ENVIRONMENTAL CONFLICT, Institute of Indigenous Studies, 6–7 (2002).

209. *Id.* at 7–8.

210. *See id.* at 7.

Despite initial approval of Ralco's EIA in 1997, the residents appealed under the 1994 Environmental Law and the 1993 Indigenous Peoples' Law, which resulted in the overturning of the EIA in 2003 after the project had reached eighty percent completion.[211] Although the Chilean government continued to support the project, international pressure and the involvement of the Inter-American Human Rights Commission ultimately convinced the Chilean government to agree to a program of sizeable payments to Pewenche families.[212] In addition, the government also agreed to ratify ILO 169, strengthen indigenous rights laws (including constitutional recognition), improve and strengthen processes for indigenous territory recognition and participation in development, and create measures for environmental protection in the Andes region of the Biobío Basin (including no additional dam projects in the area).[213]

But a more recent Chilean controversy demonstrates the value of salmon and steelhead as a focal point for conflict resolution in the Columbia River Basin. Chile's largest river (by volume) is the Rio Baker, in the southern reaches of Patagonia.[214] The Baker flows out of Lago General Carrera and passes to the east of the Northern Patagonia Ice Field before emptying into the Pacific Ocean.[215] It is one of the last free flowing rivers in the world of its size, and is an attractive location for hydroelectric development.[216] In 2011, the Chilean government approved a massive multi-dam project on the Baker and the nearby Rio Pascua known as HidroAysén.[217] Hidro-

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211. *See* Marcos A. Orellana, *Indigenous Peoples, Energy, and Environmental Justice: The Pangue/Ralco Hydroelectric Project in Chile's Alto Biobío*, 23 J. OF ENERGY & NAT. RESOURCES LAW no. 4, 511, 521 (2005).

212. *See id.* at 525.

213. *See id.* at 526.

214. Ministry of Education et al., *Our Rivers Hydrographic Data Base Chile*, http://ww2.educarchile.cl/portal.herramientas/nuestros_sitios/bdrios/sitio/ (last updated Aug. 18, 2000).

215. *Id.*

216. Aaron Nelsen/Cochrane, *Chile Dams Its Rivers to Unleash Its Economy*, TIME, May 11, 2011, http://content.time.com/time/world/article/0,8599,2070816,00.html.

217. Howard, *supra* note 193.

Aysén would be the country's largest ever energy project, consisting of five total dams and capable of providing one-fifth of Chile's total electricity supply.[218]

Despite that initial approval, HidroAysén remained extremely controversial. Even with the significant political influence of the companies involved, and the work of eight different Chilean universities that collaborated on the effort,[219] Chilean government agencies were harshly critical of the project's environmental analysis.[220] Initially submitted in August of 2008, criticism by both government agencies and citizen groups concerned with impacts to the delicate and undeveloped Patagonian ecosystem caused the proposal to be withdrawn and resubmitted nine months later.[221] The DGA also denied new water rights that were pending for the project as a result of the project review.[222] When the EIA was finally approved three years later, it included a number of conditions, including a full audit of the entire EIA.[223] Notwithstanding the initial approval, the project was ultimately rejected in 2014 by the Chilean Committee of Ministers under the advisement of the Minister of Environment.[224]

HidroAysén suggests two interesting things about Chile's current environmental context. On the one hand, that the government would reject a previously-approved project with such significant political and economic support demonstrates that both the government itself and the environmental community have made significant strides since the controversies on the Biobío in the previous two decades. Those strides are significant and should be celebrated. However, the Rio Baker is extremely far removed from the

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218. *Id.*

219. *See* Barandiaran, *supra* note 51, at 15.

220. *See* Bauer, *supra* note 12, at 641.

221. *See* Borzutzky & Madden, *supra* note 2, at 258.

222. *See* Bauer, *supra* note 12, at 630.

223. *See* Barandiaran, *supra* note 51, at 16.

224. Amanda Maxwell, *A Major Victory in Patagonia: Chilean Government Rejects HidroAysén's Dam Project*, NRDC (June 10, 2014), https://www.nrdc.org/experts/amanda-maxwell/major-victory-patagonia-chilean-government-rejects-hidroaysens-dam-project.

daily lives of most Chileans, and most Chileans are unlikely to be able to visit the area, given the high costs of travel to Patagonia. And while the opposition to HidroAysén contained a significant homegrown Chilean element, and was of some importance throughout the country, much of the opposition also came from outside Chile. The "Consejo de Defensa de la Patagonia Chilena," or Patagonia Defense Council, for example consists of dozens of different entities, many of which are not from Chile.[225]

If this is true, if a large number of Chileans lack a significant personal connection to Patagonia and the phenomenal ecosystems and landscapes that are found there, what is the future of environmental protection in that region? In the Columbia River Basin, the salmon provide a focal point around which many conservation conversations can focus. And perhaps more important, the rivers and landscapes are readily accessible to millions of Americans, both from the region and elsewhere. In Chile, there are no iconic fish species, and many Chileans lack the economic capacity to visit Chile's iconic landscapes. And one significant component of Patagonian tourism—fly fishing—is very expensive, not particularly important culturally, and, perhaps ironically, relies on non-native fish species introduced from North America and Europe.

In a climate-altered future, in which demand for low-carbon energy sources will only increase, pressure will continue to mount to approve new hydroelectric projects like HidroAysén or the proposals on the Biobío. As the American experience demonstrates—where environmental laws that once passed with near unanimous votes in Congress now struggle to find support[226]—environmental victories are always only temporary.

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225. A list of the entities that make up the Patagonia Defense Council is available here: *Patagonia Chilena Sin Represa!*, CONSEJO DE DEFENSA DE LA PATAGONIA CHILENA, http://www.patagoniasinrepresas.cl/final/quienes-somos.php. Two Americans are often considered leaders in conservation efforts in Patagonia: Yvon Chouinard, founder of the clothing company Patagonia, and the recently deceased Douglas Tompkins, founder of The North Face and Esprit Clothing. Tompkins purchased over 2 million acres in Patagonia for conservation purposes. *See* TOMPKINS CONSERVATION, http://www.tompkinsconservation.org/home.htm. *See also* Gaia Vince, *Dams for Patagonia*, 329 SCI. 382 (July 23, 2010).

226. The Senate passed the 1970 Clean Air Act with a unanimous vote; in the House there was a single dissenting vote. *See To Pass H.R. 17255*, GOVTRACK, https://www.govtrack.us/congress/votes/91-1970/h268 (last visited Oct. 6, 2016). Perhaps more surprising, the Senate passed the Endangered Species Act on a 92-0 vote. *See A Bill Providing for the Conservation, Protection and Propogation of Endangered Species*, GOVTRACK,

VI. CONCLUSION

This article's purpose is to consider what Chile's water resources experience might have to teach the Columbia River Basin about how climate change might alter its future. Although it does not provide solutions to the serious legal and environmental ramifications for anadromous fish, the "Organic Machine" of the Columbia River Basin serves its two original masters relatively well, providing substantial storage for late summer irrigation while simultaneously providing the nation's cheapest supply of electricity.[227] Chile faces an ongoing battle between those same interests, with a water infrastructure that presently seems incapable of balancing competing needs. But this is not because of any inherent advantage of American institutional regimes.

There are three reasons, at least, that might explain why there is less conflict between irrigators and hydroelectric facilities in the western United States than in Chile: First, we have built far more dams, have much greater storage capacity, and capture far more of the annual runoff than can water managers in the Biobío Basin, or anywhere else in Chile. While this does not avoid all water use conflicts, it does provide "more" water to work with, but at significant costs to riparian ecosystems, migratory fish species, and native cultures that Chileans are only beginning to experience. Perhaps more significant, most dams in the Columbia River Basin are managed by government agencies accountable to a wide variety of different interests and values, in addition to power production. Chile's private dams do not have the same obligations.

Second, the water infrastructure in the Columbia River Basin emerged as the region was undergoing significant growth in both irrigation and electricity demand.[228] Consequently, with limited exceptions (and those mostly due to geography), dams in the Columbia River Basin were designed to serve both irrigation and hydropower needs, and are managed with both purposes in mind. Fortuitously, irrigators also demand their water at a time of year when electricity use is high (due to increased use of air conditioning and

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https://www.govtrack.us/congress/votes/93-1973/s313 (last visited Oct. 6, 2016). The House passed its version (later tabled in favor of the Senate's version) on a 355-4 vote. *See To Agree to the Conference Report on S. 1983*, GOVTRACK, https://www.govtrack.us/congress/votes/93-1973/h531 (last visited Oct. 6, 2016).

227. WHITE, *supra* note 33.

228. *Id.*

irrigation pumps); thus, water can be passed through dams to serve downstream irrigators *and* produce power. In Chile, where electricity demand is much higher in winter than summer, irrigators and power producers do not share the same beneficially coincident timing of their uses. Unlike Chile, therefore, hydroelectric facilities in the western U.S. can fill their reservoirs when the water is not needed by irrigators, and pass water when it is.

Further, the Biobío Basin currently provides 19% of the electricity for Chile's entire Sistema Interconectado Central.[229] In the U.S., *all* hydropower from all river systems only accounts for 7% of our total power supply.[230] Consequently, the importance of hydropower in the Biobío is much greater, relative to irrigation. It is also important in a national, rather than a regional, sense. Chilean irrigators do not have the same political power,[231] compared to private hydroelectric companies,[232] as do U.S. irrigators.

Finally, as we begin to consider the adaptations that climate change might require, the people of the Columbia River Basin are situated in a different cultural and environmental context than contemporary Chileans. Whether it is, in fact, a culturally-unifying symbol or not, salmon provide a space for all interests to come together to consider the effects of dams on natural river systems. Salmon have also served to empower native peoples who might otherwise be excluded from river management decisions. Although Patagonia, as a region and source of national pride might ultimately serve this purpose, Chile appears to lack a similar unifying focal point.

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229. *See generally Operation Statistics 1999/2008*, CDEC SIC, (2008), www.cdec-sic.cl/anuarios/anuario2009/imagenes/cdec_ing.pdf?2cf19b. The SIC is the central power grid, serving over 90% of Chilean citizens.

230. *Hydroelectric Power Water Use*, USGS, water.usgs.gov/edu/wuhy.html (last modified May 2, 2016).

231. This is not to say that Chilean irrigators lack any political power—they were able to influence the 1981 Water Code and continue to influence water resource management. But the relative power of irrigators in the Columbia River Basin is much higher, due both to political traditions in the West as well as the security of water rights in prior appropriation systems.

232. This is another significant difference that might warrant its own independent treatment, but will only get a brief mention here. While many of the dams and hydroelectric facilities in the Columbia River Basin are owned and operated by the federal government, and thus have additional obligations to act in the public interest, all of the Chilean facilities are privately owned. They thus have none of the obligations inherent in a publicly-owned and managed system.

All of these reasons are, in part, simply accidents of history, geography, and ecology. Of course, choices to enact the New Deal, or to protect declining fish species, were not accidents. Those were conscious efforts to improve our world, both initially when we built the dams, and later when we recognized the consequences of those earlier actions. But the fact that the salmon exist for us to care about, protect, and to unify us as we consider our future, is an accident, as are the coincident demands for electricity and irrigation, the Depression that led to the New Deal, and the ensuing patriotic fervor, that motivated and justified our large dam projects.

As climate change alters hydrological and socioecological systems, these same fortuitous aspects of our overall water regime may no longer exist. Just as climate and cultural change might alter Chile's power demands and the balance of its hydropower production and irrigation needs, similar changes might unbalance our own currently precariously balanced hydropower and irrigation needs. Further, while we presently rely on public management of an enormous public infrastructure, the neoliberal policies of contemporary American governance are moving away from public ownership and management, which might lead to a future in which our water infrastructure need not consider our complex tapestry of cultural values and expectations. Similarly troubling, climate change might also further threaten salmon and steelhead populations. In the Pacific Northwest, these fish provide a continuing cultural connection to our rivers. As those fish are threatened, so too is our connection with and concern for natural rivers.

Ultimately, Chile's lesson for the western United States is perhaps both simple and obvious, but crucial nonetheless: our water resource institutions must take into account the changing cultural, hydrological, ecological, and climatic context of our region. In the past, we have avoided or successfully managed conflict between irrigators and hydropower, in part, because the specific conditions that existed at that particular time, potentially independent of the actual legal structures governing those conditions. The Chilean experience suggests that a different social, cultural, geographic, or climatic context might lead to conflicts our existing institutions are unable to address. And our changing climate suggests that we are likely to face different social, cultural, geographic, and climatic contexts in the near future. If avoiding conflict was due to a historical accident as much as our intentional actions, we must be aware that those same accidents might not happen again in the future. The Columbia River Basin will be a different place—culturally, ecologically, hydrologically, and climatically—and our water resource institutions must prepare for that.